SCIENCE ABSTRACTS.

Section A.—PHYSICS.

SEPTEMBER, 1932.

GENERAL PHYSICS.

3075. Ultra-Powerful Horizontal Pendulum with Mechanical Registration. G. Agamennone. *Accad. Lincei, Atti*, 15. *pp.* 382–385, *March* 6, 1932.—The author refers to his paper on heavy horizontal pendulums [see Abstract 1249 (1900)]. Intervening work is summarised. He describes his latest seismograph. A. D.

3076. "Nautical Almanac" Office Burroughs Machine. L. J. Comrie. *Roy. Astron. Soc., M.N.* 92. *pp.* 523–541, *April*, 1932.—The machine is a commercial one used for ledger-posting, which by adjustable controls (fully described and illustrated) may be applied to a wide range of operations involving repeated additions, subtractions and the printing of sub-totals at any stage, and is therefore specially adapted to the mechanical production of mathematical tables (its work is illustrated). The process of mechanical integration from second differences is shown, with other applications to computation from algebraic formulæ, interpolation, computation of moments in statistics, and verification of tabulated quantities. The performance of the machine is described; 30 million figures in one year without error attributable to the machine. A number of points of technique are dealt with. The author prefers the adaptation of commercial machines to the design of special apparatus on a number of grounds. T. L. M.

3077. Measurement of Very Small Angles of Rotation. G. Siadbei. *Comptes Rendus*, 194. *pp.* 1334–1336, *April* 18, 1932. *Zeits. f. Instrumentenk.* 52. *pp.* 234–235, *May*, 1932.—A thin beam of light is reflected from the bubble of a liquid level attached to the object whose rotation is to be measured. A very small rotation of the object produces a sufficient change in the position of the bubble to give a large change in the angle of incidence of the beam on the bubble surface. Angles of half a second may be measured accurately. J. E.

3078. High-Precision Measurement of Lengths and Thicknesses. M. Mennesson. *Comptes Rendus*, 194. *pp.* 1459–1461, *April* 25, 1932.—The method consists essentially of a measurement of change of pressure in air when flowing through an orifice whose section is a function of the length or thickness to be measured. A supply of air at constant pressure, regulated to within a pressure of 1 mm. of water, flows through a calibrated orifice into a vessel and thence through a second orifice whose size has to be found. The object whose dimensions are required is placed on a movable base whose distance from the second orifice is known. The air pressure between the two orifices is a function of their sectional areas and is measured by a water manometer. The sensitivity can be varied by a suitable choice of the orifice diameters and the initial air pressure.

R. S. R.

3079. Recording the Rate of Change of Slowly Varying Physical Magnitudes. G. Aprile. *Elettrotecnica,* 19. *pp.* 322–323, *April* 25, 1932.—The principle of the method described is that the recording pen undergoes at equal time-intervals, which are small compared with the rate of change of the quantity to be measured, a series of displacements proportional to the (approximately) instantaneous values of the quantity and returns immediately to zero; these displacements are recorded on a band moving at constant speed in a direction perpendicular to the direction of displacement of the pen. The time-quantity curve is then given by a line joining the ends of the lines traced by the pen. Details are given of a device operating on this principle. H. F. G.

3080. Determination of Adhesion Tension of Liquids against Solids. Microscopic Method for the Measurement of Interfacial Contact Angles. F. E. Bartell and E. J. Merrill. *J. Phys. Chem.* 36. *pp.* 1178–1190, *April,* 1932.—Equilibrium contact angles have been measured when solid-liquid-air phases and liquid-liquid-solid phases are in contact. The angles can be formed within capillary tubes and are quite independent of their size. The adhesion tension, as measured, is found to be specific and definite for a given solid-liquid system. Data are obtained by a microscopic method which show good agreement with the results afforded by the Bartell-Osterof pressure of displacement method and in consequence substantiate the assumptions made in the development of the latter method. Eleven tables of data are included.

H. H. Ho.

3081. Measurement of Viscosity of Gases over a Large Temperature Range. B. P. Sutherland and O. Maass. *Canad. J. of Research,* 6. *pp.* 428–443, *April,* 1932.—The work described is an investigation of the viscosity of air, hydrogen and carbon dioxide. The principle of damped oscillations was employed and an apparatus was built embodying many new features which make possible an accuracy greater than has hitherto been obtained. It was the attempt at the elimination of experimental error in the oscillating disc method which was the main feature of the investigation. At room-temperatures where values in the literature are reliable excellent agreement with the best data has been obtained, but at lower temperatures where there is much divergence in published values the present results are of importance as giving more reliable and accurate data than hitherto available. For hydrogen and air the temperature range + 20° to − 200° C. was covered. In the case of carbon dioxide the range was limited by its properties to + 20° to − 95° C. As the temperature coefficient of the viscosity of gases is of particular interest from a theoretical point of view, as far as the kinetic theory is concerned, the data obtained may be considered important. Incidentally, Maxwell's law concerning the effect of pressure on viscosity was confirmed at the lowest temperature range hitherto investigated. AUTHORS.

3082. Variation of the Vapour Viscosities of Normal and Isopentane with Pressure by the Rotating Cylinder Method. R. K. Day. *Phys. Rev.* 40. *pp.* 281–290, *April* 15, 1932.—The vapour viscosities of both normal and isopentane have been measured by the rotating cylinder method at different pressures ranging from a few mm. to the saturated vapour pressures, all at 25° C. Twenty-eight measurements are given for normal pentane and thirty-seven for isopentane with an estimated accuracy of 0·2 %. The plotted values for each compound show a linear decrease with pressure, the slopes being nearly the same. The results may be expressed: for normal pentane $\eta = (677\cdot 2 - 0\cdot 0084p) \times 10^{-7}$ poises; for isopentane $\eta = (696\cdot 5 - 0\cdot 0077p) \times 10^{-7}$ poises, where p is the pressure of the vapour in mm. of mercury. AUTHOR.

3083. Motion of a Flexible Profile through Liquid. U. Cisotti. *Accad. Lincei, Atti,* 15. *pp.* 165–173, *Feb.* 7, *and pp.* 253–257, *Feb.* 21, 1932.—Develops the theory of the motion of a flexible profile through liquid. Compares and contrasts it with the analogous problem of the flow of liquid past a fixed profile. Gives the conditions relative to a flexible profile; an auxiliary function ω; reference to a semicircle; limiting solution; general solution; profile under great tension; curvature of the profile; dynamical actions on the profile; applications when the profile is under great tension. A. D.

3084. Forces on a Flat Plate placed in a Stream of Fluid between Two Parallel Walls. S. Tomotika. *Phys. Math. Soc., Japan, Proc.* 14. *pp.* 139–167, *April,* 1932. *In English.*—The flow past an inclined flat plate of zero thickness placed in a stream between two parallel walls is investigated, and the forces experienced by the plate are calculated by a method analogous to that of Cisotti for the case of a flat plate in an unlimited stream of a perfect fluid. It is found that the total fluid pressure on the plate is perpendicular to the surface of the plate, in accordance with the fundamental property of a perfect fluid. The expressions for the forces on the plate reduce to those of Cisotti for the limiting case in which the distance between the walls becomes infinite. H. F. G.

3085. Examination of Turbulent Flow with an Ultra-Microscope. A. Fage and H. C. H. Townend. *Roy. Soc., Proc.* 135. *pp.* 656–677. *April* 1, 1932.—Turbulent flow of tap-water in pipes has been examined with an ultra-microscope, minute particles in the water being illuminated and viewed against a dark background. Observations of the maximum component velocities in three directions at right angles, u_1, v_1 and w_1, and of the mean velocity across the stream, were made in pipes of square and circular cross-section. At the axis of the pipe, u_1, v_1 and w_1 were approximately equal. At the wall of the pipe, flow tended to become laminar, and the particles in the laminæ moved in sinuous paths even to within 1/40,000 in. from the wall. No particle was observed to move in a rectilinear path. With increase of speed through the critical range of Reynolds number, changes of flow occurred very suddenly. There was no sign of growth in the *degree* of turbulence, but only a change in the relative frequency and duration of periods of rectilinear and turbulent flow. J. S. G. T.

3086. Distribution of Turbulent Velocities in a Fluid near a Solid Wall. G. I. Taylor. *Roy. Soc., Proc.* 135. *pp.* 678–684, *April* 1, 1932.—The unexpected increase which occurs close to the wall of a pipe in the inclination of the paths of particles to the mean direction of flow in turbulent motion is shown to be also a feature of a type of disturbance between rotating cylinders, which can be expressed mathematically.

The special features of the motion observed by Fage and Townend [see preceding Abstract] may be due to the existence of fluctuating pressure gradients at the surface transverse to the direction of mean flow, which are large compared with those in the direction of mean flow. J. S. G. T.

3087. Transport of Vorticity and Heat through Fluids in Turbulent Motion. G. I. Taylor, with an Appendix by A. Fage and V. M. Falkner. *Roy. Soc., Proc.* 135. *pp.* 685–705, *April* 1, 1932.—Taylor has previously suggested that the dynamics of turbulent motion should be regarded as an effect of diffusion of vorticity rather than as a diffusion of momentum [see Abstract 536 (1915)]. The analysis, previously applied to the case of two-dimensional motion, is now extended to three-dimensional motion, and it is shown that the " momentum transport " theory of Reynolds and Prandtl agrees with the " vorticity transport " theory in one case only, *viz.*, when the turbulent motion is of a two-dimensional type confined to the plane perpendicular to the mean motion. When the turbulent motion as well as the mean motion is confined to two dimensions, the two theories yield essentially different results. A searching test of the respective merits of the two theories is provided by the distribution of temperature and velocity in the wake behind a heated object. Measurements made by Fage and Falkner confirm the accuracy of the theoretical distributions of temperature and velocity deduced from the vorticity transport theory for the case of two-dimensional motion when the turbulent motion is confined to the plane of the mean motion. J. S. G. T.

3088. Multiple Solutions for Potential Streaming with Unrestricted Boundary. S. Bergmann. *Zeits. f. angew. Math. u. Mechanik.* 12. *pp.* 95–121, *April,* 1932.—Examples are considered of streaming between stationary walls and past obstacles, for the case in which there is only one stationary region, with the object of finding the multiple solutions of the Helmholtz problem. An extensive mathematical treatment is given, for which the original paper must be consulted. H. F. G.

3089. Theory of Plane Periodic Flow Characterised by a Boundary Layer. H. Schlichting. *Phys. Zeits.* 33. *pp.* 327–335, *April* 15, 1932.—Prandtl's theory is applied to discuss mathematically the two-dimensional motion of a fluid of small viscosity subjected to a periodic disturbance of small amplitude, *e.g.*, due to viscous forces near a boundary. The differential equation of motion is integrated by a process of successive approximations. The results are applied to interpret the characteristics of Kundt's dust figures. J. S. G. T.

3090. Plane Oblique Ballistic Waves and Conical Waves. Application to Study of Air Resistance. F. Bourquard. *Comptes Rendus,* 194. *pp.* 846–848, *March* 7, 1932.—Hugoniot's theory is applied to the case of plane waves produced by a plane or dihedral object moving obliquely through the fluid. The results are expressed by velocity diagrams analogous to hodographs. The waves produced by a dihedral surface may be represented by a series of curves giving the fluid resistance as a function of the velocity, in conjunction with a coefficient which depends on the angle, α, between the faces. The velocity necessary for the formation of a ballistic compression wave is equal to that of sound when $\alpha = 0$, and is infinite for $\alpha = 50{\cdot}65^\circ$ (assuming $\gamma = 1{\cdot}4$); for greater values of a a permanently stable condition cannot exist. Conditions behind the object may be represented by a similar series of curves. Conical waves of revolution are produced by the movement of a conical surface in the direction of its axis. The hodograph of a point O comprises a linear portion U_1U_2 corresponding to a sharp change of velocity on passing from the surface of the wave, and a curved portion U_2U_3 corresponding to continuous variation of velocity in the interior of the wave; the centre of curvature C, of U_2U_3 at U_3, is given by $OC = 2OU_3$. H. F. G.

3091. Movement of an Incompressible Fluid around an Obstacle. D. Riabouchinsky. *Comptes Rendus,* 194. *pp.* 1215–1217, *April* 11, 1932.—A mathematical discussion, based on the method of successive approximation and on Molenbroek's transformation method as given by Tchapliguine. H. F. G.

3092. Slow Movements of Compressible Fluids. B. Demtchenko. *Comptes Rendus,* 194. *pp.* 1218–1220, *April* 11, 1932.—Mathematical. H. F. G.

3093. Determination of Velocity in Eddy Streams of Infinite Extent. G. Durand. *Comptes Rendus,* 194. *pp.* 1221–1222, *April* 11, 1932.—Mathematical interpretation of an apparent paradox according to which the velocity does not vanish at infinity. H. F. G.

3094. Stability of Couette Movements. A. Rosenblatt. *Comptes Rendus,* 194. *pp.* 1310–1312, *April* 18, *and pp.* 1443–1445, *April* 25, 1932.—A mathematical investigation of periodic perturbations in the motion of a fluid contained between two co-axial cylinders. The case of movements starting from rest at zero-time is specially considered. In the second paper the initial state of the movement is considered as a function of the distance from the axis of the cylinders containing the liquid. J. P. A.

3095. Stationary Cavitations in a Liquid. H. Poncin. *Comptes Rendus,* 194. *pp.* 1312–1314, *April* 18, 1932.—For irrotational motion in fluids cavitations can exist unchanged in form as long as the circumstances which gave rise to them persist. The type of motion for which this is true is analysed mathematically. J. P. A.

3096. Electrical Analogy in Hydrodynamics. J. Pérès and L. Malavard. *Comptes Rendus,* 194. *pp.* 1314–1316, *April* 18, *and pp.* 1560–1562, *May* 2, 1932.—The paper applies to slightly more complicated cases a method similar to that employed by Taylor and Sharman [see Abstract 382 (1929)] and others to the analysis of flow past an obstacle. The equipotential lines between two or more linear electrodes situated in a dilute electrolyte are found experimentally. A comparison of the differential equations then shows how the velocity potential lines, and lines of vortices, may be obtained from the resulting diagram. A method for finding the lines of flow round a circular obstacle is described. J. P. A.

3097. Cohesion between Solid Surfaces, and Surface Energy of Solids. R. S. Bradley. *Phil. Mag.* 13. *pp.* 853–862, *April,* 1932.—The force of cohesion between two small spheres of quartz, and between two small spheres of sodium pyroborate is measured. The results agree with an expression derived from the assumption that two molecules attract one another with an inverse *n*th power law. From this expression

it is possible to compute the surface energies of quartz and sodium pyroborate to be 33·8 and 69 ergs per sq. cm. In the case of the borate spheres, however, the cohesion is probably due to a surface film of water.
J. P. A.

3098. Torsion of Composite Rods. N. Mouskhelichvili. *Comptes Rendus,* 194. *pp.* 1435–1437, *April* 25, 1932.—A general mathematical investigation, on the lines of St. Venant's work for homogeneous rods, of torsion in uniform cylinders composed of parallel rods embedded in a different elastic medium. The unique solution shows that the stresses over a section are equivalent to a pure couple when the rod is twisted about an axis parallel to the rod. J. P. A.

3099. Two-Dimensional Problem of Elastic Vibrations. V. Smirnoff and S. Soboloff. *Comptes Rendus,* 194. *pp.* 1437–1439, *April* 25, 1932.—The equation $t - \theta x \pm \sqrt{c^2 - \theta^2} \,.\, y = \psi(\theta)$, where $\psi(\theta)$ is a function of θ, defines θ as a function of x, y, t. If for any values of x, y and t, this equation has an imaginary root, the real part of $\psi(\theta)$ is a solution of the equation $c^2\frac{\partial^2 f}{\partial t^2} = \frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2}$. This theorem is applied to vibration problems in two dimensions. J. P. A.

3100. Vibrations of Revolving Shafts. D. Robertson. *Phil. Mag.* 13. *pp.* 862–865, *April,* 1932.—A critical discussion of the theoretical work of Howland [see Abstract 23 (1932)]. The author states that observations disagree with Howland's deduction that the frequency of vibration of a shaft varies with the speed of rotation. J. P. A.

3101. Equilibrium of Flat Plates. B. Galerkin. *Comptes Rendus,* 194. *pp.* 1440–1443, *April* 25, 1932.—Gives a mathematical solution of the problem of equilibrium of a thick circular plate and of a plate in the form of a sector of a circle, under various conditions of load and support.
J. P. A.

3102. Elastic Stability. R. V. Southwell. *Roy. Soc., Proc.* 135. *pp.* 601–616, *April* 1, 1932.—Direct comparison between experiments on loaded bars and Euler's theory of elastic stability is usually prohibited by a departure of the material from Hooke's law, or by the presence of small initial curvature. The simple theory, applicable to a bar loaded longitudinally and having a small initial curvature, shows that a hyperbolic relation exists between the load and the deflection of the centre of the bar. By means of a change of variable, observations satisfying the relation may be made to lie on a straight line graph, from the slope and intercept of which the least critical load may be deduced, even when the observations are confined to smaller loads. Tested upon observations of T. v. Kármán, the method gives correct values for the critical load. The analysis is applicable to other problems of elastic stability. J. P. A.

3103. Clebsch's Problem. G. Supino. *Accad. Lincei, Atti,* 15. *pp.* 366–371, *March* 6, *and pp.* 448–453, *March* 20, 1932.—Considers a slab acted upon by forces applied only at its periphery. Shows that when the resultant forces all act in the mid-plane of the slab the solution required comes within the ambit of Clebsch's problem, and the solution is easily constructed (without resolving new limiting problems) whenever the solution of the elastic problem in two dimensions is known. The second paper extends the reasoning to slabs acted upon by contour-forces not in the mid-plane. The whole, superposed, solves the general problem of the deformation of a slab of finite thickness. A. D.

3104. Impulses in Elastic Isotropic Bodies. F. Conforto. *Accad. Lincei, Atti,* 15. *pp.* 649–656, *April* 17, 1932.—A continuation of a former paper [see Abstract 2243 (1932)] and determination of a particular class of integrals of the equations obtained, integrals which can give a picture of what occurs in an indefinite isotropic elastic body when at a determined instant forces having an impulsive character act upon the elements of a surface limiting a small cavity in the interior of the elastic body. J. J. S.

3105. Law of Photoelastic Extinction. J. Kuno. *Phil. Mag.* 13. *pp.* 810–824, *April,* 1932.—The author gives theoretical solutions for the distribution of stress in a roller compressed between two parallel plates and for a thick rectangular plate compressed on its two opposite sides. Experimental measurements of the stress optical effect for these two cases were made using phenolite specimens, and the photographs of the isochromatic and isoclinic lines compared with the loci computed from the theory using the law of photoelastic extinction. It is concluded that the values of the stresses obtained experimentally by applying the law of photoelastic extinction agree fairly well with the theoretical values, although further work is necessary to establish the accuracy and usefulness of the law in the general study of two-dimensional elastic systems. W. S. S.

3106. General Propositions Involving Fermat's Principle and Allied Theorems. L. Natanson. *Acad. Polonaise Sci. et Lettres, Bull.* 7–10*A*. *pp.* 612–622, *July–Dec.,* 1931. *In English.*—A mathematical scheme is constructed for the convenient expression of Fermat's theorem. This is then applied to geometrical optics, electrostatics and the mechanics of particles. W. S. S.

3107. Resistance to the Motion of Bodies in a Powdered Medium. N. Moisseiev. *Accad. Lincei, Atti,* 15. *pp.* 377–381, *March* 6, *and pp.* 443–447, *March* 20, 1932.—Continuation of a former paper [see Abstract 2226 (1932)]. Particular cases of importance are considered: (1) The case in which the moving body is in the form of a material point. (2) The case in which the dimensions of the moving body are not great in comparison with the dimensions of the sphere of action. (3) The case in which the particles possess their own velocities with respect to the flow, assuming that the component particles of the cosmic cloud are not suspended unmoving in this cloud but move in its midst, on the assumption, first, that all the directions of velocity of the particles with respect to the centre of motion are equally probable, and second, that the magnitudes of velocity of the particles with respect to the same point are equal amongst themselves. The cases of a material point and a body of finite radius are dealt with under this head. J. J. S.

3108. Measurement of the Resistance of a Shot in a Tube. C. Cranz and H. Schardin. *Zeits. f. techn. Physik,* 13. 3. *pp.* 124–132, 1932.—After reviewing the various methods for taking the pressure/time curve, the time down the bore, and other factors concerned with the propulsion of a shot from a gun, *i.e.*, the charge, etc., the authors turn to the mathematical discussion of the factors involved. They adopt as the principle of their new method the use of the frictional resistance between the shot and the tube itself under the influence of which the tube will move in the direction of the shot. A new method is given for the determination of the pressure/time curve of the explosion in the combustion chamber of the gun, as also the relationship of the resistance of the shot to time as it traverses the bore of the gun, and is impressed in the rifling. The tube is opened at the rear and then sealed with a block of heavy mass, which can move without friction. This mass only will be moved by the increase of gas pressure in the gun, backwards, and simultaneously, under the influence of the friction from the moving shot, the tube of the gun will move forwards. There is absolutely no hindrance to the passage of the shot whatever. The accelerations of tube and breech-block are recorded both piezoelectrically and otherwise, and are thus capable of direct interpretation. Full experimental details and diagrams are given. S. G. B.

3109. Application of Appell's Equations. Margaret Wheeler. *Washington Acad. Sci., J.* 22. *pp.* 153–160, *April* 4, 1930.—Both Lagrange's and Appell's equations describe the motion of a body or system of bodies. The latter are more general, since they can be applied directly to non-holonomic and holonomic systems. A system is holonomic when the number of degrees of freedom is the same as, and non-holonomic when the number of degrees of freedom is less than, the least number of distinct coordinates. Lagrange's equations may be easily modified to apply to non-holonomic problems, while the mathematical difficulties in the application of Appell's equations to simple holonomic problems make them less useful. The advantages of the two sets of equations are compared for holonomic systems with cyclic coordinates and in the case of a cyclic system. It is concluded that Lagrange's equations have an advantage for obtaining the equations of motion of a system. Cyclic and ignorable coordinates aid in their integration by the reduction of the number of equations to be solved simultaneously. Further, one need compute only $S'_p \equiv N$ in place of the complete modified function for ignorable coordinates, and consequently it is easier to apply Appell's equations than Lagrange's in this case. R. S. R.

3110. Calculation of Errors by the Method of Least Squares. R. T. Birge. *Phys. Rev.* 40. *pp.* 207–227, *April* 15, 1932.—The paper is mainly concerned with the reliability or probable error of the most probable value of a quantity deduced from a set of experimental data, and with the probable error of this probable error. The following points are made: (*a*) Constant or systematic errors invalidate the strict application of the Gaussian error curve, but the judicious use of the latter is better than any alternative procedure. The excess of large residuals sometimes observed can be explained as due to unequal reliability of the different observations, but in a set of 500 measurements of a spectral line, made to test the point, no trace of an excess of large residuals was observed. (*b*) Given several distinct sets of observations of a given quantity, the probable error of the mean values of the various sets, treated as single observations (the external consistency), should be related in a definite way to the probable error appropriate to each of the sets (the internal consistency). If this relation fails to obtain, then the different sets must have been subject to different systematic errors and the internal consistency of each set gives no true guide as to the relative weight to be attached to that set in estimating a final most probable value. (*c*) Formulæ are given for calculating the probable error of a function whose coefficients have been evaluated by least squares. [See also Abstract 3442 (1932).] W. S. S.

3111. Reliable Method of Obtaining the Derivative Function from Smoothed Data of Observation. G. Rutledge. *Phys. Rev.* 40. *pp.* 262–268, *April* 15, 1932.—The principle of the method is to fit a polynomial of degree four on to a section of the observational curve at five equidistant values of the abscissa. The derivative of the polynomial is taken at the three inner points. The selected section is then moved on by a quarter of its length and the procedure is repeated. In this way, for each of the special abscissa values involved, three values of the derivative corresponding to three different fittings of the polynomial are obtained. These derivatives are taken to just so many figures that they all give the same result and this represents the derivative of the unknown function. W. S. S.

3112. Quasi-Ergodic Hypothesis. A. Melamid. *Acta Physica Polonica,* 1. 1–2. *pp.* 281–283, 1932. *In German.*—Rosenthal sought to prove that the quasi-ergodic hypothesis sufficed for physical applications or that on the basis of this hypothesis one can proceed to a proof that the temporary mean value can be replaced by the exact mean value. The author demonstrates two principal errors of Rosenthal's proof. The relation $\lim\limits_{T=\infty} t_1/t_2 = 1$, where t_1 and t_2 are the times the phase points remain in the two isometric regions of the energy surface, was demonstrated correctly by Rosenthal in the tube of flow, but the errors arose in the change from the equivalent to the isometric region. [See also Abstract 2302 (1932).] R. S. R.

3113. Gibbs' Hypothesis on the Tendency towards Statistical Equilibrium. E. Hopf. *Nat. Acad. Sci., Proc.* 18. *pp.* 333–340, *April,* 1932.—The methods due to Koopman [see Abstract 2301 (1932)] and v. Neumann [see Abstract 2303 (1932)] are applied to the proof of Gibbs' fundamental hypothesis concerning the tendency of an ensemble of independent systems toward statistical equilibrium. The tendency does not always exist. After a mathematical formulation of the tendency toward permanent distributions, the author derives various and necessary conditions that a given flow shows this tendency. The paper does not admit of abstracting. [See also Abstract 2304 (1932).] A. D.

3114. Reduction of Order of Canonical Systems. G. D. Mattioli. *Accad. Lincei, Atti,* 15. *pp.* 437–443, *March* 20, 1932.—Lie's theorem shows that if we have m prime integrals of a canonical system, in involution with one another, we may reduce the order of the system by $2m$ units; the author shows that it is possible to obtain the same result even when the integrals are not in involution with one another. The method is described. A. D.

3115. Existence of a Normal Derivative of a Type of Potential Function. R. L. Gomes. *Accad. Lincei, Atti,* 15. *pp.* 533–535, *April* 3, *and pp.* 642–645, *April* 17, 1932. *In French.*—A layer of density μ on a closed surface S has a potential $V(P) = \int \frac{\mu}{r} d\sigma$, where P is a point inside S, r is the distance of P from the element $d\sigma$ of S and the integral is taken over S. Conditions for the existence of a normal derivative of V are found, and the limits between which this derivative can lie, when P is a point on S, are also determined. G. C. McV.

3116. Crystal Structure of Methylbixin. H. Waldmann and E. Brandenberger. *Zeits. f. Krist.* 82. 1–2. *pp.* 77–86, *April*, 1932.—Methylbixin forms monoclinic crystals but, owing to scarcity of faces, the axial ratio could not be accurately determined. The measurements made give $a : b = 0\cdot78(9) : 1$, $\beta = 120^\circ\ 54' \pm 3'$. For the unit cell, $a = 10\cdot56$ Å., $b = 13\cdot4$ Å., $c = 20\cdot62$ Å. The number of molecules per unit cell is 4 and the probable space system is C^5_{2h}–$P2_1/a'$ (new international nomenclature). The optical properties are also discussed. T. H. P.

3117. Crystal Structure of Malachite. H. Brasseur. *Zeits. f. Krist.* 82. 1–2. *pp.* 111–126, *April*, 1932. *In English.*—Malachite is monoclinic, the unit cell has a 9·38, b 11·95, c 3·18, β 91° 3′, and contains 4 molecules of $CuCO_3$, $Cu(OH)_2$, space group C^5_{2h}–$P2_1/a$. The Cu atoms are in two groups, four in positions 0°, 75° and 45°, etc., and four in 95°, 37·5° and 225°, etc. The CO_3 groups are probably midway between two planes of Cu-atoms. C. A. S.

3118. Crystal Structure and Molecular Configuration of Simple Derivatives of Tetramethylmethane. G. Wagner and G. Dengel. *Zeits. f. phys. Chem. Abt.B.* 16. 4–5. *pp.* 382–396, *April*, 1932.—The three compounds $C(CH_2Cl)_4$, $C(CH_2Br)_4$, $C(CH_2I)_4$ are monoclinic. They are not piezoelectric, which suggests the holohedral class C_{2h}. The iodine member shows etch-figures to correspond. The elementary cell in each case contains one molecule, and the space group is taken to be C'_{2h}, with molecular symmetry C_{2h}. The shape of the molecule appears to be a much flattened tetrahedron. F. I. G. R.

3119. Organic Molecular Compound with Small Unit Cell. K. Schneider. *Zeits. f. phys. Chem. Abt.B.* 16. 6. *pp.* 460–464, *April*, 1932.—Acenaphthene forms with styphnic acid a molecular compound giving monoclinic crystals: $I_a = 9\cdot05$, $I_b = 14\cdot8$ and $I_c = 6\cdot8$ Å., density 1·46. Thus the X-ray analysis shows that the lattice of styphnic acid is not retained. Bragg's formula indicates that the unit cell contains $2C_{12}H_{10}, C_6H_3O_8N_3$. It cannot be stated to which space group the crystals belong. The molecules cannot be arranged in accordance with the three-dimensional alternation principle. T. H. P.

3120. Secondary Structure and Mosaic Structure of Crystals. F. Zwicky. *Phys. Rev.* 40. *pp.* 63–77, *April* 1, 1932.—A brief summary is given of some of the essentials of the theory of secondary structure. This structure is very sensitive to external disturbing effects which frequently cause the transition of crystals from thermally stable into thermally pseudo-stable configurations for which the term mosaic structure is proposed. A discussion of the relation of the mosaic structure to the secondary structure is given. It is shown that several very fundamental causes are operative during the growth of crystals which endanger the formation of thermally stable configurations. The most important of these causes is due to the fact that on solidification the heat of fusion must be carried away from the growing surface. The resulting temperature gradient very often is great enough to produce plastic deformations in the crystal *in status nascendi*. Finally, a short review is given which intends to show that the adoption of the conception of a secondary structure and the closely related mosaic provides an adequate basis for the understanding of the totality of phenomena which is characteristic for the solid state of matter. AUTHOR.

3121. X-Ray Investigation of the n-Mono-Alkyl Malonic Acids. D. Coster and A. v. d. Ziel. *K. Akad. Amsterdam, Proc.* 35. 1. *pp.* 91–98, 1932.—Henderson's conclusion is confirmed, *viz.*, in the case of the *n*-mono-alkyl malonic acids there is only one molecule between successive reflecting planes, the two active carboxyl groups of the same molecule saturating one another. Beginning with C_6, the higher members of the series show the phenomenon of alternation in grating constant for the odd and even numbers, whereas the lower members do not show such alternation, but form a series of their own which is different from the odd as well as from the even higher members, a parallelism also exhibited by the melting points and solubilities in benzene. The photochemical action of X-rays is discussed. H. H. Ho.

3122. X-Ray Analysis of the Structure of Diphenyl. J. Dhar. *Indian Journ. Phys.* 7. *pp.* 43–60, *April* 1, 1932.—Intensities of X-ray diffraction from the diphenyl crystal do not correspond to the arrangement of molecules along any cell-face. It has been found, however, by the " trial and error " method, that the plane of the molecule is nearer to the *b–c* plane than the *a–c* plane. The correct position is obtained by giving two successive rotations, first about the *c*-axis and next about the *b*-axis, to the extent of 32° and 20° respectively. In conformity with the space group C_{2h}^5, the rotations of the two molecules are the same about the *b*-axis, but equal and opposite about the *c*-axis. The two benzene rings in each molecule are flat regular hexagons lying in one plane. The distance between the consecutive carbon atoms in each ring from centre to centre is 1·42 Å., whereas the length of the C–C bond connecting the two benzene rings is 1·48 Å. The results are quite in accord with the optical and magnetic measurements. AUTHOR.

3123. X-Ray Studies on Single Crystals of Bismuth. A. Goetz and R. C. Hergenrother. *Phys. Rev.* 40. *pp.* 137–150, *April* 15, 1932.—An X-ray analysis of different types of Bi single crystals is described, the object being to decide whether or not the differences in density, electrical conductivity and thermal e.m.f. observed between Bi crystals grown within and those grown outside of a transverse magnetic field are caused by a change in lattice spacing or are due to an alteration of the atomic parameter. No such changes are found, and the effects in question are ascribed to variations in the lattice, the period of which is too large to be detectable by X-ray analysis. This implies the assumption of very large " mean free paths " for the electrons in a crystal. J. T.

3124. Classification of Silicates. F. Laves. *Zeits. f. Krist.* 82. 1–2. *pp.* 1–14. *April*, 1932.—A topological aspect of Bragg's work [see Abstract 3926 (1930)]. Discussion of the Si:O ratio applied to the following types: Orthosilicates $(SiO_4)^{4-}$ groups; self-contained groups, $(Si_2O_7)^{6-}$, $(Si_3O_9)^{6-}$, $(Si_4O_{12})^{8-}$, $(Si_6O_{18})^{-}$; Si—O chains, $(SiO_3)^{3-}$, $(Si_4O_{11})^{6-}$; Si—O nets, $(Si_2O_5)^{2-}$; quartz lattice, (Si, Al)O_2. The Si : O ratios considered are 1 : 4, 1 : 3, 2 : 5, 1 : 2. The dimensional number of the Si—O "edifice" increases with this ratio. F. I. G. R.

3125. Variations of Crystal Habit in Pure Potassium Chlorate. H. E. Buckley. *Zeits. f. Krist.* 82, 1–2. *pp.* 31–36, *April,* 1932. *In English.*—Habit variation is always dependent upon the rate at which crystal material reaches the surfaces of a growing crystal. In $KClO_3$ the process is mechanical; it is a function of the position of the crystal in the concentration currents. Planes (110), (100), (011), $(10\bar{1})$, advance rapidly, but become partially if not totally obliterated, leaving (001) with great preponderance. F. I. G. R.

3126. Growth of Potassium Chlorate Crystals in Presence of Ionic Impurities. H. E. Buckley. *Zeits. f. Krist.* 82. 1–2. *pp.* 37–49, *April,* 1932. *In English.*—In the main paper the author considers particularly the effect of ammonium molybdate upon $KClO_3$ crystals. Apparently the effect upon the habit is not due to the simple $(M_0O_4)^{2-}$ ion but to some complex condensation product. This occurs for dilute concentration. At moderate concentrations $(CrO_4)^{2-}$ acts, and at high concentrations a number of oxy-radicals. The clinodomes {011} are the planes affected. A note on some excessively thin crystals of $KClO_3$ follows. F. I. G. R.

3127. Influence of Foreign Substances on the Cohesion Limits and Ultramicroscopic Sol Formation of Synthetic Rock-Salt Crystals. Part II. H. Schönfeld. *Zeits. f. Physik,* 75. 7–8. *pp.* 442–467, *April* 20, 1932.—Investigation of the crystals from purest sodium chloride melts of different origins reveals marked differences in all cases. Inclusions of Na_2SO_4, $NaNO_3$, $BeCl_2$, $MgCl_2(MgO)$, $CaCl_2$, $SrCl_2$ and $BaCl_2$ in DeHaen NaCl have been systematically investigated. Large increases in the cohesion limits occur only with those alkali earth chlorides ($CaCl_2$, $SrCl_2$) which can be regarded as molecular-disperse. With ultramicroscopic separation ($MgCl_2$, $BaCl_2$) little or no effect is observed. [For Part I see Edner, Abstract 2276 (1932).] T. H. P.

3128. Mixed Crystals of Nitrates of the Alkaline Earths. H. T. Ringdal. *Zeits. f. Krist.* 82. 1–2. *pp.* 50–58, *April,* 1932.—For all proportions, $Ba(NO_3)_2$–$Sr(NO_3)_2$ and $Ca(NO_3)_2$–$Sr(NO_3)_2$ give mixed crystals. Vegard's additivity law is accurately obeyed. F. I. G. R.

3129. Glide Planes as the Cause of Distortions in Calcite. O. Mügge. *Zeits. f. Krist.* 82. 1–2. *pp.* 59–71, *April,* 1932.—Mechanical discussion of distortion in tabular calcite crystals with respect to the face $(01\bar{1}2)$. F. I. G. R.

3130. Discontinuous Translation in Zinc Crystals. E. Schmid and M. A. Valouch. *Zeits. f. Physik,* 75. 7–8. *pp.* 531–538, *April* 20, 1932.—Investigation of the extension of zinc crystals for small deformation. The translation observed shows discontinuities, connected apparently with a relaxation effect. Discussion of the influence of impurities upon the critical stress. F. I. G. R.

3131. Interatomic Distances in Covalent Molecules and Resonance between Two or More Lewis Electronic Structures. L. Pauling. *Nat. Acad. Sci., Proc.* 18. *pp.* 293–298, *April,* 1932.—With the aid of tables (not yet published) the author has constructed a table of radii for non-metallic atoms in covalent molecules. These radii are designed especially for purely covalent compounds, in which fluorine forms one electron-pair bond, oxygen two, nitrogen three, etc., but they are applicable also to other compounds, such as $(CH_3)_3N:\underset{\cdot\cdot}{\ddot{O}}:$. Often two or more reasonable Lewis formulæ for a molecule can be written, and the present data provide considerable discriminating information. It is shown that resonance between two or more structures leads to interatomic distances nearly as small as the smallest of these for the individual structures. **Correction,** *ibid.*, pp. 498–499, July, 1932. H. H. Ho.

3132. Influence of a Magnetic Field on Crystallisation. D. Samuracas. *Comptes Rendus,* 194. *pp.* 1225–1227, *April* 11, 1932.—Experiments have been made with solutions of ferrous sulphate, nickel sulphate, cobalt chloride, copper sulphate and magnesium sulphate. The solutions were supersaturated, and two series of experiments were carried out in a field of about 13,000 gauss; in one series a bud crystal was introduced while in the other this was not done. Tables show the effect of the magnetic field on the mass of crystals deposited for both cases, and a number of observations on the way in which the field affects the position of the crystals are recorded. H. N. A.

3133. Second Report of the Committee on Atomic Weights of the International Union of Chemistry. *Am. Chem. Soc., J.* 54. *pp.* 1269–1279, *April,* 1932.—The following changes in the table of atomic weights are recommended: Kr 83·7 instead of 82·9, and Xe 131·3 instead of 130·2. Observations are dealt with, using physico-chemical methods, by T. Batuecas on the normal density of N_2O, by D. Le B. Cooper and O. Maass on the densities of CO_2 and SO_2, and by H. S. Patterson, R. Whytlaw-Gray and W. Cawood on the limiting density of CH_3F; they find for the atomic weight of fluorine 19·013. They have also dealt with the density of Xe, and H. E. Watson with that of Kr. Using chemical methods G. P. Baxter and C. H. Greene have determined gravimetrically the ratio $Ag:NH_3$, and from this an atomic weight of N is calculated in excellent agreement with the international value. Hönigschmidt has corrected the gravimetric results of the complete AgCl syntheses of Hönigschmidt and Bedr Chan, using a new value for the solubility of AgCl in water. Work on iodine has been carried out by different investigators; the results are compared with those of Aston. Work done on other elements by the physical methods is mentioned. The committee agrees unanimously with Aston's opinion that it is advisable for chemists to retain the present chemical standard, while in physics the oxygen isotope O^{16} seems to be the better standard. H. N. A.

3134. Choice of the Basis for Atomic Weights. S. Meyer. *Phys. Zeits.* 33. *pp.* 301–302, *April* 1, 1932.—Agrees with Aston that it is too soon to give up, for chemical purposes, the atomic weight 16 for the ordinary mixture of the oxygen isotopes. This, however, cannot continue indefinitely, since it has been shown that the ratio $O^{16}:O^{18}$ in ordinary oxygen is not constant. As to taking hydrogen as the basis, it seems possible that H^2 and H^3 nuclei may exist with two or three protons. Even helium might contain He^3 nuclei or even He^5 nuclei. A table shows the possible ways in which the elements from H to F might be built up out of α-particles, protons and neutrons. Each of these ways would correspond with a different packing factor. H. N. A.

3135. Periodic Properties of Atomic Nuclei. G. I. Pokrowski. *J. de Physique et le Radium,* 3. *pp.* 150–154, *April,* 1932.—On certain assumptions it is deduced that nuclei of analogous physical properties should have the following atomic weights: 1^3, 2^3, 3^3, 4^3, 5^3 and 6^3. C. A. S.

3136. Elastic Reflection of Atoms from Crystals. C. Zener. *Phys. Rev.* 40. *pp.* 178–184, *April* 15, 1932.—The reflection of atoms by a crystal surface is examined by a modification of the Born collision method. The fraction of reflections in which all the normal coordinates of the crystal remain unaltered is found to be approximately

$$U = e^{-3\pi^2(m_A/m_B)(t_A/\Theta)^2(t_B/\Theta)/(1+4\pi d/\lambda)}$$

m_A, m_B are the masses of the reflected atom A and of the lattice atoms, respectively. The energy of atom A is kt_A. The temperature of the lattice is t_B. Θ is the characteristic temperature of the lattice. d is the distance in which the mutual repulsion between atom A and lattice atoms falls to $1/e$ of its value. λ is the de Broglie wave-length of atom A. For reflection of H atoms on LiF at room-temperature, U is estimated to be 0·9. When Θ and t_A are comparable, those normal coordinates are found to be most readily excited which have the lowest frequency. AUTHOR.

3137. Electronic Structures of Polyatomic Molecules and Valence. R. S. Mulliken. *Phys. Rev.* 40. *pp.* 55–62, *April* 1, 1932.—The electronic structures of a number of molecules and ions (H_2O, NH_3, CH_4, CF_4, CI_4, ClO_4^-, $SO_4^=$, ClO_3^-, $SO_3^=$, CO_2 and others) are briefly described in terms of one-electron wave functions; other molecular types are easily described in a similar way, and will be discussed in later detailed papers. Many valence phenomena can be understood using these wave functions and a simple rule based on the Pauli principle. AUTHOR.

3138. Valency and Deformation Oscillations of Simple Molecules. Parts I, II and III. R. Mecke. *Zeits. f. phys. Chem. Abt.B.* 16. 6. *pp.* 409–437, *April, and* 17. 1. *pp.* 1–20, *April,* 1932.—Part I deals with the general theory, whereby the characteristic frequencies of polyatomic molecules are divided into valency and deformation oscillations. Part II discusses triatomic molecules, *viz.*, the extended molecules CO_2, CS_2, N_2O, HCl, and the angular molecules H_2O, H_2S, SO_2, NO_2, CH_2Cl_2, CH_2Br_2 and CH_2I_2, whereby important structural conclusions are drawn. Part III considers CH_4, C_2H_4, C_2H_2 and various halogen derivatives, the characteristic frequencies being discussed in detail and an interpretation derived for the Raman and ultra-violet spectra. H. H. Ho.

3139. Allotropy in Liquids. Part II. A. Smits. *K. Akad. Amsterdam, Proc.* 35. 2. *pp.* 186–193, 1932. *In German.*—The present paper supplements a previous publication [see Abstract 2575 (1931)] and discusses further experimental data respecting liquid transition points, for ether, helium and nitrobenzene. H. H. Ho.

3140. Critique of Recent Quantum Theories. R. J. Seeger. *Nat. Acad. Sci., Proc.* 18. *pp.* 303–310, *April,* 1932.—A continuation of previous work [see Abstract 2967 (1931)]. The author points out that the discovery of the dependence of the integral character of quantum numbers on the dimensions of configurational space stamped the new methods of quantum mechanics as heuristic. Critical notes are given on (1) the expression of the general equation of motion in Poisson's brackets and its extension, by analogy, to quantum mechanics, (2) the quantum conditions, (3) the matrix form, and (4) the linear harmonic oscillator with damping. H. L. B.

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3141. Wave Equations of an Electron in a Real Form. D. Meksyn. *Phil. Mag.* 13. *pp.* 834–844, *April,* 1932.—In a previous paper [see Abstract 3056 (1930)] the author showed that Dirac's wave equations for a free electron can be derived in a five-dimensional invariant form. It is now shown that these equations can be represented in a *real* five-dimensional form which can be suitably modified to include the case of an external electromagnetic field. It is found that in all cases where Dirac's equations have imaginary periodic solutions, the real equations have real periodic solutions, and the correct energies for transitions are obtained. The difficulty in Dirac's equations that the same relativity wave equations are obtained for positive and negative particles, does not arise with the real equations which, together with their solutions, differ for positive and negative charges. W. S. S.

3142. Dirac's Equation. A. Proca. *J. de Physique et le Radium,* 3. *pp.* 172–184, *April,* 1932.—The author here develops from the mathematical point of view the relationship which exists between the four classical components of the wave-function of Dirac, and the sixteen components introduced in the preceding papers [see Abstracts 3943 (1930) and 1115 (1932)]. H. L. B.

3143. Reflection of a Dirac Electron at a Potential Barrier. K. Umeda. *Tokyo B.D. Sci. Reports,* 1. *Sec.A. pp.* 203–218, *April* 30, 1932. *In German.*—The passage of an electron through a potential barrier given by the function $V(x) = Pe^{2\pi x/e}/(1 + e^{2\pi x/e})$, where x is a cartesian coordinate and P and e are constants, is discussed on the relativistic theory of Dirac. It is verified that the transition from positive to negative momentum on passing through the barrier is to be expected only when the increase of potential is very sudden. G. C. McV.

3144. Configuration Space and Dirac's Method of Quantisation. V. Fock. *Zeits. f. Physik,* 75. 9–10. *pp.* 622–647, *April* 29, 1932.—The relationship between the method of quantised wave-functions and that of coordinate space is investigated. Dirac's operators (representing what the author calls *zweite Quantelung*) are represented as a series of configuration spaces for 1, 2, 3 . . . , particles. These expressions lead to a simple method of deriving Hartree's equations, account being taken of interaction. [See following Abstract.] H. L. B.

3145. Dirac's Method of Quantisation. P. Jordan. *Zeits. f. Physik,* 75. 9–10. *pp.* 648–653, *April* 29, 1932.—The relationship between the two different methods of treating the problem of many bodies by means of equivalent particles, *viz.*, the coordinate space method and Dirac's method [see preceding Abstract], becomes considerably clearer if, instead of simply proving the equivalence of the eigenfunctions that occur in both cases, the matrices which occur in both cases are compared. H. L. B.

3146. Spatial Quantisation of the Atom by a Light Wave. J. Blaton. *Acad. Polonaise Sci. et Lettres, Bull.* 7–10 *A. pp.* 599–611, *July–Dec.,* 1931. *In German.*—In a previous work [see Abstract 3420 (1931)] it was shown that the intensity of scattered light of double the incident frequency is reduced to zero by optical interference, but it was there assumed that the atom in its undisturbed state corresponded to a spherically symmetric eigenfunction. This assumption is now relaxed and the undisturbed state of the atom is taken to have directional degeneracy. It appears that the perturbation produced by a linearly polarised light wave results in the degeneracy being removed, provided account is taken of the change of phase of the light within the atom dimensions. As in the case of a spherically-symmetric undisturbed eigenfunction, the absence of scattered light of double the incident frequency is again established. In other words, excited atoms will also fail to yield coherent "double" scattering. W. S. S.

3147. Expressions for the Number and the Mass of the Photons of the Electromagnetic Field in Vacuo. F. J. Wiśniewski. *Acta Physica Polonica,* 1. 1–2. *pp.* 31–35, 1932. *In French.*—The writer considers complex solutions of Maxwell's equations for empty space, and shows that these satisfy two further equations which are of the form of continuity equations. Supposing the complex solutions considered to be those appropriate to photons of a given frequency, the two continuity equations are interpreted as conservation of the mass of the photons and conservation of the number of the photons. When there are several kinds of photons present, the partial density of each kind is found to depend on the field due to the others and appears as a periodic function of space and time. W. S. S.

3148. Influence of Space Charge on the Structure of de Broglie Waves. S. E. Szczeniowski and L. Infeld. *Acta Physica Polonica,* 1. 1–2. *pp.* 37–46, 1932. *In English.*—The author considers the electron beam, in an electron diffraction experiment, as it passes through the field-free space between the slit and the surface of the diffracting crystal. At the two ends of the path the electric potential has a common value, but owing to space charge it is not constant along the path. The law of variation of the potential is evaluated, and this is then inserted into Schrödinger's equation and it is found that the eigenenergies are slightly lowered, *i.e.*, the de Broglie wave-length of the electrons is increased slightly. On the other hand the refractive index of crystals for de Broglie waves exceeds unity and the electron wave-length is decreased inside the crystal. This latter effect is in the opposite direction to, and is usually large compared with, the space-charge effect. Some experiments of Davisson and Germer indicate, however, that the space-charge effect may come into play. The space charge besides increasing the wave-length also results in a widening of the diffraction line of the same order of magnitude as the wave-length shift. W. S. S.

3149. Zero Velocities in the Problem of Three Bodies. Kiveliovitch. *Comptes Rendus,* 194. *pp.* 1317–1318, *April* 18, 1932.—A discussion of the types of motion which are required when in three gravitating masses A, B and C the velocity of A or B becomes instantaneously zero relative to that of C. J. P. A.

3150. Singular Points in the Problem of Three Bodies. Kiveliovitch. *Bull. Astronomique,* 7. 3. *pp.* 75–127, 1932.—Employing a transformation due to Levi-Civita, which conserves the canonical form of the equations of motion in the problem of three bodies, the author considers in great detail the following problems: (1) a simple form for the conditions giving a collision between two of the bodies, (2) the possible orbits of the third body, supposed of negligible mass, in the neighbourhood of a collision between the other two. (3) Periodic orbits with collisions between two of the bodies. (4) Multiple collisions in the problem of three and of *n* bodies. G. C. McV.

3151. Convergence of the Series in the Problem of Two Bodies. D. Belorizky. *Comptes Rendus*, 194. *pp.* 1449–1452, *April* 25, 1932.—A determination of the radii of circles of convergence of the series which give the solution by Levi-Civita's method of the problem of two bodies under the inverse square law. G. C. McV.

3152. Existence of the Ether. J. Mackaye. *Frank. Inst., J.* 213. *pp.* 421–438, *April*, 1932.—The questions of absolute rotation and of the nature of collision problems are dealt with. It is claimed that these furnish evidence for the existence of an ether and that the pronouncements of the theory of relativity with regard to them are fallacious. G. C. McV.

3153. Deflection of Light by the Sun. R. J. Trümpler. *Zeits. f. Astrophysik*, 4. 3. *pp.* 208–223, *April* 11, 1932. *Science*, 75. *pp.* 538–539, *May* 20, 1932.—The method of calculation of the deflection of light by the sun [see Abstract 360 (1932)] is criticised. The observers attempted to obtain the absolute deflection by means of a grating covering the observed field and using the photographs of a comparison field for the calibration of the grating. Defects in this procedure are pointed out which make the calculations untrustworthy. If the scale-correction of each plate is determined from the plate itself the value deduced for the deflection is $1''\cdot 75 \pm 0\cdot 19$ instead of the Potsdam result of over $2''$ and is thus in agreement with relativity theory. The values for this deflection obtained in 1922 are also defended. In a reply **E. F. Freundlich, H. v. Klüber** and **A. v. Brunn** state that Trumplers' method of calculation is no more trustworthy than their own "absolute" method and attribute the difference in the value of the deflection to a difference in the weighting of the experimental results with which they do not agree. G. C. McV.

3154. Distant Universes. C. S. Beals. *Roy. Astron. Soc., Canada, J.* 26. *pp.* 145–160, *April*, 1932.—A popular account of the spiral nebulæ with special reference to the methods of determining their distances. The theory of the expanding universe to account for the velocity of recession of these objects is also dealt with. G. C. McV.

3155. Cosmological Problem in Relativity Theory. G. Maneff. *Zeits. f. Astrophysik*, 4. 3. *pp.* 231–240, *April* 11, 1932.—A discussion of the de Sitter, Schwarzschild and other "statical" solutions of the equations of general relativity. G. C. McV.

3156. Expansion and the Mean Density of the Universe. A. Einstein and W. de Sitter. *Nat. Acad. Sci., Proc.* 18. *pp.* 213–214, *March*, 1932.—The line-element of space-time applicable to the universe as a whole is assumed to be such that, at any given instant, the spatial section is flat and of infinite extent whilst space-time as a whole is always curved. If the cosmical constant λ is also assumed to be zero, then it is possible to deduce from the velocity of recession of the nebulæ that the mean density of matter in the universe should be 4×10^{-28} gm. cm^{-3}. This is higher than the actual estimated density. The authors conclude by saying that more accurate measurements are required before the curvature of space can be definitely determined. G. C. McV.

3157. Expansion of the Universe. G. Maneff. *Zeits. f. Astrophysik*, 4. 3. *pp.* 241–246, *April* 11, 1932.—The condition is found which ensures that a Lemaître universe does not expand with a velocity greater than that of light. G. C. McV.

METEOROLOGY, GEOPHYSICS AND ASTROPHYSICS.

3158. Fuess-Robitzsch Bimetal Actinometer. M. Robitzsch. *Gerlands Beitr. z. Geophys.* 35. 3–4. *pp.* 387–394, 1932.—Within the last two years a great number of actinometers have been made according to the following designs: one consists of two flat bimetal laminae of different colours, mounted horizontally and having a maximum error of 5 %; the other type, having three elements, has a maximum error of 1 %. The colours must be light- and weather-proof and lampblack and zinc white are used. The glass cover limits the action to the visible spectrum as heat rays affect both metals equally. By the use of two actinometers the effect of the direct sunlight is obtained from the difference between the effects due to the total light from the sun and sky, and light from the sun alone. A table and diagrams show that all actinometers made after this pattern are in good agreement with one another. When due care is taken the apparatus may be carried from place to place and used without loss of accuracy. H. M. B.

3159. Measurements of Ultra-Violet Sunlight in the Tropics. Parts I and II. J. Clay and T. Clay-Jolles. *K. Akad. Amsterdam, Proc.* 35. 1. *pp.* 69–82, *and* 35. 2. *pp.* 172–185, 1932.—Part I records observations (together with comprehensive experimental procedure) on the intensity of ultra-violet solar radiation in Bandoeng, the method adopted being based on the use of the cadmium cell with electrometric discharge, Elster and Geitel's photoelectric photometer as modified by Günther and Tegetmeyer being employed. Part II contains measurements of the diffuse ultra-violet and of photographic sunlight in Bandoeng. The observations are discussed from the standpoint of how far the illumination of the sky may be considered uniform and whether the spectral composition of the diffuse light deviates from that of the direct sunlight. H. H. Ho.

3160. Solar Radiation and Temperature Conditions during the Ice Ages. R. Spitaler. *Gerlands Beitr. z. Geophys.* 35. 3–4. *pp.* 395–407, 1932.—More exact values than in an earlier paper [see Abstract 1895 (1932)] have been calculated for the temperature conditions in the ice ages. The year was subdivided into 12 periods with equal changes of perihelion for monthly values, and into 4 for seasonal values. Values are then tabulated of (1) the formulæ employed to obtain the mean radiation, (2) the mean monthly temperature for the year and for summer and winter with eccentricities of 0 to 0·07, (3) the mean monthly temperatures over land and water for the same periods and eccentricities, (4) the mean summer and winter temperatures and their differences in the northern hemisphere for latitudes 0°–60° with eccentricities 0 to 0·07 for perihelion and aphelion. From the tables it is evident that the maximum difference of temperature occurs in the north over land and in the south over water, while the mean yearly temperature is constant for all eccentricities and varies only with change of solar radiation, transparency of the atmosphere or any cosmic action, and the effect of temperature changes in explaining the ice ages must be considered before these other factors. R. S. R.

3161. Solar Radiation as a Meteorological Factor. H. H. Kimball. *Rev. Modern Physics,* 11. *pp.* 259–277, *April,* 1932.—The variations in the heat received at the surface of the earth due to extra-terrestrial causes are compared with those due to terrestrial, and the effects of such variations on climate are discussed with examples. It is concluded that changes in the intensity of solar radiation, which never exceed 1 %, have little effect, but that for further knowledge of climatic variations investigation of the polar-equatorial exchange is essential, for which purpose numerous and accurate observations near the poles are required. C. A. S.

3162. Transparency of the Lower Atmosphere. H. Buisson, C. Jausseran and P. Rouard. *Comptes Rendus,* 194. *pp.* 1477–1479, *April* 25, 1932.—Using as sources of light, cadmium, zinc and aluminium arcs, and quartz-fluorite or quartz-rock-salt lenses, the absorption due to thicknesses of air (horizontal) of 2–800 m. was determined, giving as the optical density of 1 km. of air:

	Cadmium				Zinc				Aluminium				
λ............	2313	2265	2195	2144	2139	2100	2063	2026	1950	1935	1863	1858	1855
Optical density	1·37	1·77	2·35	2·71	3·20	4·10	3·40	4·35	5·10	17·0	250	370	445

The inversion for λ2063 of Zn is due to the oxygen absorption bands.

C. A. S.

3163. Radiation and Absorption in the Atmosphere. D. Brunt. *Roy. Meteorolog. Soc., J.* 58. *pp.* 103–113, *April,* 1932.—A consideration of the problems of solar radiation. The temperature gradient in the troposphere is first taken and the dependence of fog, frost and cloud formation on the short-wave solar radiation and the long-wave radiation from the earth's surface is considered. In the stratosphere, comment is made upon the various theories given to account for the constant temperature and the variation of height of the tropopause over the equator and the poles. Practical results are quoted which point to the earth's radiation being the dominant factor in determining conditions in the stratosphere. American meteorologists have found a daily variation in the solar radiation, and Simpson has pointed out that a marked increase in this radiation would produce conditions favourable for an ice age. It is suggested that the views at present held as to the radiative processes in the ozone layer require reconsideration. H. M. B.

3164. Determination of the Density of Atmospheric Ozone. H. Mineur. *J. de Physique et le Radium,* 3. *pp.* 145–149, *April,* 1932.—Rosseland's method of determining the density of ozone at a given height [see Abstract 1357 (1930)] requires a knowledge of the absorption produced by ozone at all heights above that height. A theoretical method is now given for deducing the density of ozone at any height from surface observations of the absorption undergone by a ray of any zenith distance, but for practical results such zenith distance must be 90° or very near thereto. Numerical results are promised. C. A. S.

3165. New Upper-Air Pressure Indicator. A. K. Das. *Gerlands Beitr. z. Geophys.* 36. 1. *pp.* 1–3, 1932. *In English.*—A glass bulb is connected to bent or spiral glass tubing with a pellet of concentrated H_2SO_4 along the tubing. After calibration to find the internal pressure when the pellet is expelled, the apparatus is attached vertically in a glass vacuum vessel to a pilot balloon. The pellet acts as a chemical trigger and causes an explosion and smoke when expelled. The height is calculated from observations on a balloon pendant. Several such indicators are used to obtain successive pressures and heights. The apparatus has been in daily use at Alipore since August, 1931; it is very cheap, and it gives rapidly the variation of pressure with height. The results so far obtained are of value for local weather forecasting, while certain characteristic variations in the lapse rate of pressure at Alipore appear to be associated with the evolution of depressions in the Bay of Bengal. [See following Abstract.] R. S. R.

3166. Inexpensive Upper-Air Temperature Indicator. A. K. Das, B. B. Roy and D. N. Dasgupta. *Gerlands Beitr. z. Geophys.* 36. 1. *pp.* 4–6, 1932. *In English.*—The apparatus described [see preceding Abstract] has been used to indicate the temperature lapse rate. The open end of the glass tube projects into a small cylindrical airtight vessel of thin glass or copper containing an explosive mixture. When calibrating the apparatus, the explosive chamber is cooled to the desired temperature and the pellet of concentrated H_2SO_4 arranged to be then at the open end of the glass tube. The apparatus is then sealed, attached to a pilot balloon and the height found where the explosion occurs by observation of a pendant and the smoke from the explosion. A series of temperatures and heights are rapidly obtained. R. S. R.

3167. Formation of a Secondary Minimum from a V-Shaped Depression or an Independent Anticyclone from a Wedge of High Pressure. J. M. Angervo. *Gerlands Beitr. z. Geophys.* 35. 3–4. *pp.* 265–290, 1932.—Considerable doubt often exists when attempting to predict from charts of weather and pressure tendencies either of these two new pressure distributions, and still more, when the event is anticipated, to predict at what time and locality the new system will be found. The author gives a mathematical treatment for these predictions by considering the pressure at the ground as a function of latitude, longitude and time. A central line is selected in the V-shaped depression, or high-pressure wedge, such that pressure changes are equally distributed on the two sides and the position of this line and pressure changes around it at a later time are calculated. The formulæ are simpler in the case of a symmetrical pressure field. Examples are given of the method from Finnish weather charts for 3 high-pressure wedges, 5 V-shaped depressions and one weak extension of a depression. R. S. R.

3168. Dependence of Turbulence Coefficient on Vertical Temperature Distribution. H. Ertel. *Gerlands Beitr. z. Geophys.* 35. 3–4. *pp.* 291–294, 1932.—Exner used the empirical formula $\mu = c/(k - a)$, in which μ is the eddy viscosity and a the vertical temperature gradient in the atmosphere. He identified k with β the limiting vertical temperature gradient for constant density. An attempt is made to obtain the above formula theoretically and a value for μ with $(\beta - a)$ in the denominator is obtained. The term in the numerator appears at first as a function of the height, but is subsequently reduced to a constant. H. M. B.

3169. Atmospheric Circulation. H. Ertel. *Gerlands Beitr. z. Geophys.* 36. 1. *pp.* 7–10, 1932.—It is shown that Baur's alteration of the 2 in Bjerknes' equation [see Abstract 1135 (1932)]

$$dC/dt = -\oint(1/\rho)\mathrm{grad}_s p.ds - 2\omega dF/dt$$

to 4 is incorrect. In a Reply, **F. Baur,** *ibid.*, pp. 11–12, accepts the correction, but on other grounds. [See following Abstract.] C. A. S.

3170. Atmospheric Circulation. Maria Lombardini. *Accad. Lincei, Atti*, 15. *pp.* 459–462, *March* 20, 1932.—In the calculation of this circulation, F. Baur [see Abstract 1135 (1932)] is at variance with other writers. The author has discovered a flaw in his reasoning, correction of which restores harmony. [See preceding Abstract.] A. D.

3171. Measurements of the Size and Number of Cloud Drops for the Study of the Coagulation of Non-Homogeneous Clouds. W. Findeisen. *Gerlands Beitr. z. Geophys.* 35. 3–4. *pp.* 295–340, 1932.—A photographic method of cloud investigation was employed and with it the formation of non-homogeneous clouds with drops of different size could be followed and coagulation phenomena in them studied. The cloud drops were photographed in the natural state with dark field illumination and small magnification. The distribution and number of drops of various sizes could be found. Natural clouds in Hamburg were all found to be non-homogeneous. Köhler's hypothesis regarding the coagulation of equally large drops, based on observations of natural homogeneous clouds, was not supported because of the large number of big drops. Artificial non-homogeneous clouds produced in a laboratory, under continuous observation, showed a variation with time in the number of drops of different sizes. The coagulation velocities confirm, satisfactorily, calculations following from a theoretical treatment of coagulation in electrically uncharged non-homogeneous clouds. The different rates of fall of drops of different sizes in these clouds are also decisive, drops of unequal size uniting more readily, and consequently completely non-homogeneous clouds coagulate very much faster than initially homogeneous clouds. R. S. R.

3172. Height and Colour Distribution of Mother-of-Pearl Clouds. C. Störmer. *Geofysiske Publ.* 9. 4. [27 *pp.*], 1932.—Mother-of-pearl clouds were observed near Oslo at 8.45 hours M.E.Z. on January 13th, 1929. Towards sunset observations were made at Oslo and Oscarsborg (27·36 km. S.) while 92 pairs of pictures were taken and 38 of these used for height measurements. During the day the clouds had irisation like altocumulus and a series of colours at different places ranging from red and weak violet to weak green. Towards sunset there was a sharp series of colours, red, violet, green, yellow and blue. Diagrams illustrate the shape and colouring of the cloud as observed by Refsdal, and notes are supplied on colour changes. Height measurements indicated a fall of 0·3 m./sec. from 25 to 23·5 km. At the time, pressure was low to the north of Norway with temperature 4° C. above normal and a dry warm föhn wind at Christiania. These clouds are often obscured by others at lower levels. They differ from illuminated night clouds in that the latter are at 80 km. of bluish-white colour and show no spectral colours. A large series of sketches and notes on coloration are given of mother-of-pearl clouds seen at Oslo between 13 and 15 hours on January 1st and 15th, 1890. R. S. R.

3173. Residual-Mass Percentage Rainfall Records for the British Isles. A. A. Barnes. *Engineering*, 133. *pp.* 510–511, *April* 29, 1932.—Based on rainfall figures for Derbyshire published in the *Roy. Meteorolog. Soc., J.*, Vol. 58, No. 244, p. 115, 1932, the author sets out in a table the rainfall each year as a percentage of the normal, the residue each year (difference from normal) and the residual mass (figure obtained by adding the residues year by year). The normal taken is that for 44 years, which is stated to be the best average and balances wet and dry years. This leads to the conclusion that a sequence of 22 wet years is now ending and the succeeding 22 years will be relatively dry. R. S. R.

3174. Psychrometer Constant. M. Robitzsch. *Gerlands Beitr. z. Geophys.* 35. 3–4. *pp.* 382–386, 1932.—Reference is made first to the simplified psychrometric formula. Since this is not valid under all circumstances another formula is derived $\frac{B - 2 \cdot 4e_m}{1550 - 1 \cdot 68t_m}(t_1 - t_0) = E_0 - e_1$, where B is the barometric pressure, e_m the mean vapour pressure and t_m the mean temperature at which the measurements are made, E_0 the saturation vapour pressure at t_0, and e_1 the vapour pressure in the surrounding air at temperature t_1. This equation holds for extremes of temperature and low pressures, but under normal conditions the simplified psychrometric formula is stated to be sufficient. R. S. R.

3175. Heat and Humidity Interchange above Lake Constance. R. Marquardt. *Gerlands Beitr. z. Geophys.* 36. 1. *pp.* 78–132, 1932.—Various theories as to the *régime* of interchange of heat and humidity between air and water through mass movement, evaporation, conduction and radiation are discussed, and on certain assumptions, chief of which is the existence of a thin non-turbulent "limit-layer" of air immediately above the surface of the water, a formula, depending on coefficients of exchange, $A = \rho K$, and of transition, $H = a/r$ (K = coefficients of eddy diffusion, ρ = density of air, a = exchange coefficient in the limit-layer, r = its thickness) is deduced, whence the change in temperature and humidity on passing from the shore over a water surface can be calculated. These results are compared with observations made during 2½ years over Lake Constance, and by aid of numerous tables and diagrams shown to be in satisfactory agreement therewith. C. A. S.

3176. Late Winter and Late Summer on the Earth. R. Spitaler. *Gerlands Beitr. z. Geophys.* 35. 3–4. *pp.* 408–418, 1932.—The solar radiation for individual months was calculated from Hopfner's formula using 12 equal periods and not calendar months and tabulated for each month, and also the difference of each from the yearly mean for latitudes 0°–60°. Corrections are next applied to obtain monthly values over land and water and thence the actual monthly values. The difference of calculated and observed values are similarly tabulated. These show that spring in both hemispheres is colder and autumn warmer than the calculated values, while the difference is greater in the northern hemisphere where more land occurs. Melting of the ice in spring plays a large part. To show this more clearly, monthly temperatures are reduced to centre at the 21st and again tabulated. The values of temperature differences are next set out for a number of places in different latitudes for pairs of months with equal solar radiation. The maximum differences occur in September and March and decrease away from these times. The effect is greatest for continental and least for oceanic sites and little affected by height above sea-level. [See Abstract 1875 (1932).] R. S. R.

3177. Projection of Circles on a Mercator Map. S. Gold. *Roy. Astron. Soc., Canada, J.* 26. *pp.* 161–170, *April*, 1932.—An account is first given of the theory of the Mercator map projection and an azimuth distance map for Ottawa on a Mercator projection is given. Distance circles at intervals of 10° and azimuth lines at intervals of 20° are drawn and equations for these plane curves deduced. Three cases occur in which the circle intersects the meridian (1) between the centre and the pole, (2) at the pole, and (3) beyond the pole, and each case is discussed. Equations are found for great circles passing through a given point and making a given angle with the meridian through the point when projected on the Mercator map. Distance lines and azimuth lines generally form part of a detailed study of an earthquake and its effects. These lines are drawn about and through the epicentre of the earthquake. R. S. R.

3178. Norwegian Arctic Expedition in the Gjøa, 1903–1906, under the Conduct of Roald Amundsen. Part I. *Geofysiske Publ.* 6. [248 *pp.*], 1932.

3179. Surface Waves. Part II. T. Itoo. *Gerlands Beitr. z. Geophys.* 35. 3–4. *pp.* 349–356, 1932.—The fundamental equations of surface waves are first obtained and applied to certain special cases. To obtain the connection between the absorption and viscosity coefficients two cases are considered in which part of the energy of wave propagation is transformed into heat, the force being proportional to (1) acceleration, and (2) velocity. A comparison is made with expressions for visco-elastic media. The visco-elastic medium can be considered as an elastic medium with heat loss, and one can obtain for it the new wave-length and the coefficient of shearing viscosity. With increasing wave-length, the wave velocity decreases. With the passage of surface waves, the surface particles describe elliptic spirals, but with no heat loss closed elliptic paths are followed. [For Part I, see Abstract 3742 (1931).] R. S. R.

3180. Investigations on Dispersion with Earth Waves. H. Landsberg. *Gerlands Beitr. z. Geophys.* 35. 3–4. *pp.* 370–373, 1932.—For considerations of preliminary earth waves dispersion is especially important. Sommer indicated normal, anomalous and no dispersion for Alaskan earthquakes. Gutenberg, Landsberg and Wilip dealt with their possible suppression by the instrument chosen. Results from a Galitzin long-period and a Wiechert short-period pendulum at De Bilt show the differences. Using for dispersion the ratio of the periods for the 1st and 2nd minutes there were (1) 25 cases for the ratio $= 1$, (2) 8 cases for < 1 and (3) 4 cases for > 1. According to Gutenberg's theory anomalous dispersion occurs for (2) and normal dispersion for (3). Case (3) occurs at Munich, Budapest, Strasburg and Agram. The results are set out in a table for stations where no suspicion exists of modification of the waves. Anomalous and normal dispersion appear to depend on distance, but the effect may be accidental. R. S. R.

3181. Angles of Emergence in Strong Earthquakes. K. Frisch. *Gerlands Beitr. z. Geophys.* 36. 1. *pp.* 13–19, 1932. *In English.*—Seismograms, as recorded at Tartu, of earthquakes in Mexico, China and New Zealand are reproduced, and the angles of emergence and azimuths of the seismic waves, and positions of epicentre for all three earthquakes, and coefficients of extinction and velocities of the surface waves of the first and last calculated. The velocities, v_1, v_2, v_3, are respectively 3·7, 3·4, 3·1 and 3·23, 3·50, 3·53 km./sec. C. A. S.

3182. Cyclones and Microseisms. E. Gherzi. *Gerlands Beitr. z. Geophys.* 36. 1. *pp.* 20–23, 1932. *In English.*—The microseisms observed during cyclones are due to the rapid changes in atmospheric pressure at any one point. The sea waves caused by such cyclones may be a contributory cause at some places, but are not the chief cause. C. A. S.

3183. European Records of Earthquakes of July 18, 1928, October 24, 1930, and November 13, 1925. I. Lehmann and G. Plett. *Gerlands Beitr. z. Geophys.* 36. 1. *pp.* 38–77, 1932.—Path-time curves are deduced from the seismograms of the earthquakes of (1) July 18, 1928 (Peru), (2) October 24, 1930 (Mariana Islands), and (3) November 13, 1925 (Philippines) recorded at 41, 56 and 27 stations. From (1) curves for P, $\overline{S_cP_cS}$ and S_n, (2) for PP, $\overline{S_cP_cS}$, S_n, PS and SS; and (3) for P, PP, $\overline{S_cP_cS}$ were determined. Indications of some of the above and of other phases, *e.g.*, $\overline{S_cP_cP_cS}$, PPP, PPS, were present in various seismograms, but too irregular to be used; there were also marked variations in the same phase as recorded for different earthquakes. These are discussed in detail, as also the amplitude ratio PP/P, which is very variable but seems to increase with distance to a value $\ngtr 2$ at Δ 100°. [See Abstracts 943 and 3663 1930).] C. A. S.

3184. Geophysical Prospecting. A. B. B. Edge. *Roy. Soc. Arts, J.* 80. *pp.* 553–575; *Disc.*, 575–579, *April* 22, 1932.—Geophysical methods of prospecting are reviewed. Gravimetric and seismic methods are best employed for the determination of the larger structural features, such as those found in oil-fields. The gravimetric method is slow and expensive, and for most purposes can be superseded by the seismic system. Electrical methods are mostly used for locating metalliferous bodies, especially those containing sulphide ores; but have been of late extended to structural and water-supply problems. The magnetic method is used in ore prospecting, and has been usefully employed in conjunction with other forms of geophysical survey. With regard to depth the success of geophysical methods is in practice confined to a few thousand feet. W. A. R.

3185. Determination of Salt-Water Horizons in Oil-Bearing Anticlines. A. Belluigi. *Gerlands Beitr. z. Geophys. Angew. Geophys.* 2. 4. *pp.* 337–343, 1932. *In English.*—Employing a modification of Levi-Civita's formula [see Abstract 1085 (1929)] for electromagnetic induction expressions are deduced involving the depth of a salt-water horizon, treated as a horizontal conducting sheet of indefinite extension. The actual measurements required involve phase determinations, reducing to measurements of maximum effect, which within limits depend on the frequency of the a.c. used. C. A. S.

3186. Asymptotic Effects of Tides on the Motion of Celestial Bodies. G. Krall. *Accad. Lincei, Atti,* 15. *pp.* 219–225, *Feb.* 7, *and pp.* 371–376, *March* 6, 1932.—Discusses the method used in the problem of two bodies by Darwin (who makes use of Kelvin's suggestion as to tides exercising a dissipative action), and the statistical method used by Levi-Civita in the same problem. Then, in the first of these two papers, the author develops the problem of two bodies, under the successive headings of the total energy of the kinetic energy of regular precessional movement of a gyroscopic body, a digression on the stationary solutions of Routh and Levi-Civita, the limiting state of minimum energy, the subordinate stationariness of the characteristic function of two bodies gravitating and rotating. In the second paper the author extends to the problem of three bodies, showing that the tides reduce the total energy to a minimum, so as to fix the plane of the movement normal to the axes of rotation, and that the angular velocities of revolution and of rotation tend to equality. The orbit tends to become circular round the barocentre of the masses. The problem of *n* bodies is amenable to similar treatment. A. D.

3187. Numerical Verification of the Contraction Hypothesis. F. Nölke. *Gerlands Beitr. z. Geophys.* 35. 3–4. *pp.* 374–381, 1932.—An exact verification of the hypothesis of contraction can be obtained from astronomical observations, the secular variations of the mean motion of the sun and moon. A definite portion of the accelerations cannot be ascribed to the disturbing influences which the bodies of our solar system undergo by their mutual attraction. As these parts are not in the ratio of the mean motions of the sun and moon, the sun and moon must be exposed separately to special influences. The earth undergoes an acceleration of rotation which is, however, neutralised by factors delaying the rotation. The acceleration of rotation of the earth can be explained only by a contraction of the globe, and an exact foundation is thus obtained for the hypothesis of contraction. The investigation also shows that the moon is slackening its motion and therefore extending its orbit. For the amount of the globe's shrinkage, as well as for the extension of the moon's orbit, originating in the friction of the tides, values are found which, in the periods of time to be assumed for the development of the earth and moon, lead to a thoroughly appropriate order of magnitude. R. S. R.

3188. Method of First Approximation in the Determination of Planetary Orbits. N. Stoyko. *Bull. Astronomique,* 7. 2. *pp.* 33–60, 1932.—The general problem consists of a determination, from three complete observations, of the six unknowns of the problem, the orbit elements. Instead of the latter auxiliary unknowns are introduced (1) geocentric distances, and (2) a geocentric distance and the projection of the heliocentric speed of the star. Sometimes instead of (1) heliocentric coordinates are used. Three types of methods are considered: (1) Laplace, which is direct, and the law of Newton is applied without investigation; (2) Gauss, and (3) Lagrange, the integrals of the Newtonian movement being used for (2) and (3). The equations established by many different authors in applying these methods are discussed. To a first approximation (2) and (3) give practically the same result and differences enter only when terms of a higher order are introduced. In the mean the accuracy with the Laplace method is not greater than for results obtained by the Gauss, while it is less than that for the quasi-Laplace methods. R. S. R.

3189. Planetary Motion: The 3 : 1 Resonance Case. D. B. Ames. *Roy. Astron. Soc., M.N.* 92. *pp.* 542–556, *April,* 1932.—Resonance occurs when the mean motions of two bodies are nearly in the ratio of two integers; a general method originated by E. W. Brown is sketched. The 2 : 1 case introduces the eccentricity, the 3 : 1 case the inclination also; there are two principal librating angles; the conditions to be satisfied are laid down. The regions of libration are then found for the cases (i) inclination = 0, (ii) eccentricity = 0. Brief notes on maximum values are given and an interesting mathematical analogy between the fundamental equation for the libration of the angle N and the ordinary equation of the simple pendulum is worked out. T. L. M.

3190. Chromosphere in 1931. G. Abetti. *Accad. Lincei, Atti,* 15. *pp.* 258–260, *Feb.* 21, 1932.—Measurements of the heights of the solar chromosphere in the different regions of the sun during the year 1931, with notes as to the comparative data of recent years. A. D.

3191. Theory of the Fraunhofer Lines. P. ten Bruggencate. *Zeits. f. Astrophysik,* 4. 2. *pp.* 159–171, *March* 4, 1932.—The theory is developed for the case that the ratio of scattering to true absorption is not constant in the solar atmosphere. It is found that the atmosphere will probably be unequally heated, and this is suggested as a possible cause for granulation. If the ratio of absorption and scattering coefficients is an arbitrary function of the optical depth, this function cannot be uniquely determined without adopting some theory of the natural line-width. However, the observation of line-contours along a radius of the sun allows us to determine the function with any desired approximation. The variation of the absorption alone can also be evaluated. The method is obviously not applicable to stars. R. d'E. A.

3192. Electrical Properties of the Sun. A. Dauvillier. *R.G.E.* 31. *pp.* 303–311, *March* 5, 1932.—The author bases his views on an assimilation of faculæ to the kathode spot of a Cooper–Hewitt arc, and suggests that slow electrons emitted there are accelerated in the sun's electrical field. The sun's field is attributed to ionisation of the chromosphere by extreme ultra-violet radiation, equilibrium being maintained by the loss of positive ions from the prominences. The author attributes the corona, zodiacal light, etc., to the accelerated electrons. [See following Abstract.] T. L. M.

3193. Terrestrial Electromagnetic Phenomena produced by Solar Emission. A. Dauvillier. *R.G.E.* 31. *pp.* 443–455, *April* 2, *and pp.* 477–488, *April* 9, 1932.—Electrons emitted by the sun [see preceding Abstract] describe geodesics in the earth's magnetic field; secondary electrons follow the lines of force, due to the ionisation of the high atmosphere. The permanent or Nordenskjöld aurora is accounted for and illustrated experimentally [see Abstract 1326 (1932)]. A detailed explanation of auroral phenomena, especially as observed by the author at Sodankylä in 1931–2, is given on the basis of his theory of solar emission. Theories of the aurora are discussed leading to the requirement of the two types of emitted electron. The altitude and curvature of the lower border of auroral luminosity give some measure of the energy of the electrons. X-rays produced in the high atmosphere are proposed as the origin of cosmic radiation; the test must be the tracing of the solar cycle in the latter. Great importance is given to the permanent general aurora; its existence is used to explain the vertical atmospheric current and, the geodesics being the Faraday field, the daily variation and other phenomena of terrestrial magnetism. T. L. M.

3194. Variations of the Solar Constant. F. Baur. *Zeits. f. Astrophysik,* 4. 3. *pp.* 180–189, *April* 11, 1932.—It is demonstrated that the new solar-constant observations of the Smithsonian Institution still include an annual variation in the value of the constant, which must be due to terrestrial causes. The main part of the paper is devoted to finding a correlation between the variations of the solar constant and sunspot-frequency for the period 1919–1931. All that can be said is that maximum values of the solar constant prevail between maxima and minima of sunspots, whilst minimum values of the constant are found at those maxima or minima. The correlation of maxima and minima of sunspot frequency with abnormally severe winters in Europe for the period 1793–1931 is fairly high. G. C. McV.

3195. Mean Light Curves of Long-Period Variables. Part VI. R Cygni. A. A. Nijland. *K. Akad. Amsterdam, Proc.* 35. 1. *pp.* 33–39, 1932. *In German.*—The periodic elements of the light alternation of R Cygni are deduced from 729 observations made in the years 1904 to 1931. [For Part V, see Abstract 1575 (1932).] J. E. K.

3196. Energy Curve of Star P Cygni. J. Dufay. *Comptes Rendus,* 194. *pp.* 1454–1456, *April* 25, 1932.—A relatively low colour temperature is assigned to many bright-line B stars, of which number P Cygni (type BI) approaches the Novæ in spectrum and shows emission lines of hydrogen (H_α–H_ϵ). The author derives its colour temperature from a table of spectrophotometric, colorimetric and visual observations and this indicates that as the mean wave-length λm increases the colour temperature seems to decrease; the energy curve, then, of P Cygni is not that of a black body. Baillaud has suggested the emission of a continuous spectrum of atomic origin in the stellar atmosphere; the distribution of energy being sensibly uniform from $0 \cdot 2\,\mu$ to $0 \cdot 6\,\mu$ in the continuous spectrum of simple gases (H, He, O, N), conditions favourable for its production occur in certain stars. If this radiation is compared with a black body, a colour temperature, T, is found such that the energy radiated by the black body is a maximum for wave-length λM near λm, but a little shorter because of the dissymmetry of Planck's curve. It yields $\lambda m T = 2886 + \epsilon T$ micron-degrees, and P Cygni, therefore, is of the order of 100 micron-degrees. If the distribution of energy is constant, the product $\lambda m T$ should be very nearly constant and near 3000 micron-degrees. This is in accordance with the table (with one exception of a measure of Lindblad). Gerasimovic's spectrophotometric measures are precise and indicate that between $0 \cdot 4\,\mu$ and $0 \cdot 55\,\mu$ the curve on the uniform distribution of energy hypothesis passes well through his first observations, and for wave-lengths inferior to $0 \cdot 38\,\mu$ this curve takes account of the great intensity of the ultra-violet spectrum noted by Yü. This hypothesis accords better with the facts than does that of a black body, but measures further into the infra-red and ultra-violet (especially) will be decisive. The abnormal colour of certain B stars, whose spectra give intense light both in the yellow and in the ultra-violet (unlike a black-body radiation), may be similarly explained. A. S. D. M.

3197. Photographic Proper Motions of Stars in Two Regions. Violet F. White. *Roy. Astron. Soc., M.N.* 92. *pp.* 519–523, *April,* 1932.—Plates of M27 and 52 Cygni, taken by W. E. Wilson in 1894 and 1899, were repeated in 1931 at University of London Observatory, through the glass of the plate; measurements of the plates, film to film, are used to derive proper motions of stars down to about $12^{m\cdot}$, with reference to stars of 13–$14^{m\cdot}$. Comparisons of the results with the few other determinations are given. The systematic motions of 172 stars (subdivided into magnitude groups) and 86 stars in the respective regions are discussed and the Eddington diagrams given. T. L. M.

3198. Theory of Streaming of the B Stars. K. Ogrodnikoff. *Zeits. f. Astrophysik,* 4. 3. *pp.* 190–207, *April* 11, 1932. *In English.*—A continuous arbitrary distribution of stellar velocities for stars near the sun is assumed and the residual radial velocities and motions parallel to the galactic plane are calculated theoretically. These motions are found to depend on four parameters, which are determined experimentally for the B stars. The resulting values are not those which the parameters would have in the rotational theory. It also follows that practically the entire K-term is to be ascribed to real motion. If the motion is due to an attraction under the inverse square law, the local system of stars must be moving in a parabolic orbit in a direction some 20°–30° away from the galactic centre. G. C. McV.

3199. Distribution of Residual Velocities of B Stars. P. Guintini. *Comptes Rendus*, 194. *pp*. 1452–1453, *April* 25, 1932.—The residual velocity of a star is defined as the difference of its velocity with respect to the sun and the average velocity of the region in which the star occurs. The velocity ellipsoid so determined is only slightly extended at the vertices and not much flattened at the poles. There is, further, no evidence for the asymmetric star-streaming found by Strömberg, nor does the residual velocity appear to vary with position in the galactic plane of the region considered. G. C. McV.

3200. Construction and Use of Artificial Spectral Lines Scale with Application to Absolute Magnitudes of Early Type Stars. E. Öpik and Margaret Olmsted. *Harvard College Obs., Circ.* 369. [19 *pp*.], *April* 20, 1932.—Ideal qualitative resemblance with observed lines (for a dispersion of 5 to 8 mm. between Hγ and Hδ) can be got by using three different sequences of artificial lines, but in practice the authors found it convenient to apply a single sequence which, though not quite homogeneous, gives satisfactory results. The scale is made by a number of Indian ink artificial-line contours drawn so that the relative albedos (a_0 and a_1) at a given point are equal to the residual intensity (r) in the corresponding portion of the assumed line contour, giving $r = 1 - s(1 - a_1/a_0)$, where s is the fraction of area covered by the ink. Since a_1/a_0 is small, $r = 1 - s$ very nearly, and s is obtained by tracing parallel lines of a certain known width b, at intervals d, such that $s = b/d$; the width of the line is kept at a few round values from 0·15 to 0·90 mm., and the right depth of shading is got by changing d (always less than 2·5 mm.). The method of measurement, the stars measured, the influence of continuous background, the effective width of a spectral line, the true central depth, the influence of gradation upon depth estimates and of inclination in width, and the accuracy of estimated total absorption are all discussed. A comparison is made with Miss Williams' measurements with the Moll microphotometer data, and a list of total absorptions and absolute magnitudes is given for 119 stars. A. S. D. M.

3201. Opacity of Stellar Matter and the Hydrogen Content of Stars. B. Strömgren. *Zeits. f. Astrophysik*, 4. 2. *pp*. 118–152, *March* 4, 1932. *In English*.—It is assumed that the relative proportions of the elements are roughly those found by Russell for the sun. The approximate Rosseland mean absorption coefficient is then calculated directly, and over a considerable range it is found nearly equal to Eddington's theoretical figure except (*a*) at high densities and (*b*) at high temperatures with small Z. H and He contribute to the opacity only in so far as they affect the number of free electrons (and, of course, the actual figure for the density). The He proportion is uncertain and probably small; the H

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proportion is then varied until a value for the absorption coefficient is obtained, in the case of any one star, which leads to the correct value for the radius. This is done for Eddington point-source models and the usual Eddington model. It is found that for Sirius, Capella and the sun the H proportion is nearly the same (about $\frac{1}{3}$ by weight), but for B stars it appears to be appreciably greater. H content is then correlated generally with position in the Russell diagram, the giant-dwarf sequence being taken as the " normal line "; massive B stars and faint giants lie on opposite sides of this line and depart in opposite senses also from the normal H proportion. R. d'E. A.

3202. Total Absorption of H_α in B and A Stars. A. Unsöld. *Zeits. f. Astrophysik*, 4. 2. *pp*. 172–174, *March* 4, 1932.—The total absorption of H_α is measured in certain stars of types B5–A5. These measurements and similar ones of Elvey and Keenan are used to derive the total number of 2-quantum H atoms per sq. cm. of photosphere as a function of the spectral type. AUTHOR.

3203. Intensities of Bright Balmer Lines in Stellar Spectra. O. Struve. *Zeits. f. Astrophysik*, 4. 3. *pp*. 177–179, *April* 11, 1932.—A method for calculating the intensities is given which, when applied to the emission lines of hydrogen in Be-stars, gives the ratios $H_\beta : H_\gamma : H_\delta : H_\epsilon = 10 : 4 : 3 : 2$ for the intensities. These are in agreement with experiment. G. C. McV.

3204. Origin and Evolution of Stars and Amorphous Nebulæ according to Dualistic Cosmogony. E. Belot. *Comptes Rendus*, 194. *pp*. 1321–1323, *April* 18, 1932.—Nebulosities are of two kinds: black, of great relative density; and light, whose ionised elements indicate cosmic collisions with great velocities. The author attributes the origin of super-giant stars to the collision of two dark nebulæ, with relative velocity of about 2000 km./sec., becoming vortices. The nebulous masses thus concentrated by collision give tube-vortices, insuring great rotation in the resulting stars. He follows our sun through the stages of super-giant, proto-sun giant, nova and dwarf sun, giving the radius, equatorial velocity, density, pulsation, equatorial force and temperature for the various stages. A. S. D. M.

3205. Evolution of Binary Stars. W. Markowitz. *Astrophys. J.* 75. *pp*. 69–105, *March*, 1932.—A statistical study of binary systems to discover which, if any, of the four known causes capable of changing the period P, the semi-major axis a and the eccentricity e, *viz.*, (i) tidal action, (ii) perturbations by other stellar systems, (iii) friction by a resisting medium, and (iv) secular decrease of mass, can account for the types of binaries observed. The action of tides is shown to increase P very slightly. The densities of the components of eclipsing variables are shown to be independent of their relative separations, and hence the components cannot be contracting. It is also probable that their absolute separations are decreasing. Secular decrease of mass cannot increase P either. A resisting medium also decreases P, a and e, and the effect of collisions, even for long-period binaries, cannot be great. The general conclusion is that short-period spectroscopic binaries have not evolved into long-period systems. G. C. McV.

LIGHT.

3206. Validity of Lambert's and Beer's Laws for Colloids. B. Lange. *Zeits. f. phys. Chem.* 159. *Abt.A.* 4. *pp.* 277–294, *April*, 1932.—According to the theory of Soós, Beer's law should show deviations according to the size of colloid particles. Using semi-conducting photocells, extreme dilutions have been investigated and such deviations have not been found. Beer's law of dilution is proved for colloids and the numerous deviations shown to be of a colloid-chemical nature. The accuracy of the spectrophotometric method used is discussed. [See two following Abstracts.]
F. S.

3207. Absorption of Aqueous Solutions of Potassium Permanganate. B. Lange and C. Schusterius. *Zeits. f. phys. Chem.* 159. *Abt.A.* 4. *pp.* 295–302, *April*, 1932.—The absorption was measured with a photoelectric photometer [see preceding Abstract]. The positions of absorption bands are determined and are compared with those given in the literature. Deviations from Beer's law at extremely high dilutions were not found. F. S.

3208. Absorption of Water in the Visible Region. B. Lange and C. Schusterius. *Zeits. f. phys. Chem.* 159. *Abt.A.* 4. *pp.* 303–305, *April*, 1932.—The absorption between 4000 and 8000 Å. was determined by a photoelectric photometer [see two preceding Abstracts], and absorption maxima found at 6000, 6600 and 7500 Å. The increase of absorption for short waves depends principally upon the purity of the water. F. S.

3209. Absorption of Light. R. A. Houstoun. *Optical Soc., Trans.* 33. 2. *pp.* 63–65, 1931–1932.—The paper describes a verification of the law of the absorption of light in liquids and glasses over a range of intensity of 1 to 15,000. The speculative views of the nature of light held at present in many quarters render it possible that the law may break down, and attention is called to the desirability of further work on the subject.
AUTHOR.

3210. Transmitting Power of Thin Platinum Films in the Range of Wave-Length $0\cdot25\,\mu$–$2\cdot5\,\mu$. E. Schuch. *Ann. d. Physik*, 13. 3. *pp.* 297–314, *April* 20, 1932.—Measurements of the transmitting power of thin platinum films such as are used in spectrophotometry are carried out over the range $0\cdot25\,\mu$–$2\cdot5\,\mu$. The thinnest films exhibit an increase in transmitting power with increasing wave-length, whereas the thickest films display the converse effect. A film of medium thickness has been prepared which is nearly neutral in the range $0\cdot25\,\mu$–$1\cdot0\,\mu$. It would appear that the dependence of transmitting power on wave-length and thickness of every film to be used in accurate spectrophotometry should be first investigated. Reflecting powers of the films in the visible region are measured. From the reflecting and transmitting powers the thickness of a film is calculated by means of Goldschmidt and Dember's formula.
N. D.

3211. Variation in the Ultra-Violet Transmission of Glasses due to Irradiation with "Quartz" Light. R. Lassé. *Helv. Phys. Acta*, 5. 2. *pp.* 92–101, *April*, 1932. *In German.*—Specimens of ordinary mirror glass and Uviol mirror glass were subjected for 18 hours to intensive irradiation from a quartz-mercury-vapour lamp. A slight browning of the surface of the glasses was observed, which is to be attributed to a photochemical transformation of iron, and possibly manganese, oxides. The transmissions of the glasses for ultra-violet light of wave-length 300–400 mμ were determined by a method based on the blackening of a photographic plate. For the glasses before irradiation the ratio of transmissions; ordinary glass: Uviol glass, equalled 1 : 0·2. Irradiation caused a reduction in transmission of 34 % for ordinary glass, 19 % for Uviol glass. It would require probably more than 100 years of exposure to ordinary sun and daylight to bring about the effects here induced by intensive irradiation with "quartz" light. W. S. S.

3212. Young's Theory of Colour Vision. J. H. Parsons. *Optical Soc., Trans.* 32. 5. *pp.* 165–183, 1932.—The author first gives a short *résumé* of Thomas Young's work on colour vision as described in his published writings. He then goes on to trace the development of research on the various aspects of the trichromatic theory, *viz.*, the redetermination of the mixture curves, the sensation curves and the curve of hue discrimination. S. Hecht's theory of the sensation curves is described and its interpretation of the hue discrimination curve is given. The second part of the paper deals with the phenomena of colour-blind vision. Lasareff's investigations of the photochemistry of the visual purple, and modern work on the electrical response of the retina to light stimuli, are then described. The whole paper forms a general account of the present position of the trichromatic theory of colour vision. J. W. T. W.

3213. Visibility of Ultra-Violet Radiation and the Light Absorption of the Parts of the Human Eye. P. Bächtiger. *Helv. Phys. Acta.* 5. 2. *pp.* 102–105, *April*, 1932. *In German.*—Qualitative measurements, using an iron arc and a Hilger spectroscope, were made of the absorption of the different parts of the human eye. The retina transmits ultra-violet light between 300 and 400 $\mu\mu$, equally as well as visible light. The lens begins to absorb rapidly at 400 $\mu\mu$. The cornea shows absorption first at 315 $\mu\mu$, while the aqueous and vitreous humours show no appreciable absorption down to 305 $\mu\mu$. Thus the visibility of radiation ceases at the wave-length at which absorption by the lens begins. The known fact that cataract patients whose eye lenses have been removed can see radiation of wave-length much less than 400 $\mu\mu$, *may* be due to the effect of fluorescence. Tests with two cataract-operated patients showed that they could see the lines in the iron spectrum down to 335 $\mu\mu$, and, moreover, they saw them as sharp lines with no sharp change in intensity at about 400 $\mu\mu$. This indicates that radiation down to 335 $\mu\mu$ serves as a direct light stimulus to the retina, *without* the intermediary of any fluorescence effect. Another conclusion from this work is that ultra-violet radiation down to 335 $\mu\mu$ is no more harmful to the retina than visible light. W. S. S.

3214. Sensitive Control of Light Intensity by Means of Mirror Membranes. C. Müller. *Zeits. f. techn. Physik*, 13. 4. *pp.* 171–180, 1932.—A description is given of a new apparatus for controlling the intensity of a light beam, which has a greatly increased sensitivity, gives true frequency and amplitude reproductions, and is independent of colour and temperature. The essential part consists of a plane metal membrane mirror, thickness $1 - 2 \times 10^{-4}$ mm., which can be flexed either directly by sound waves or by electrostatic or electromagnetic fields. The curvature imparted determines the position of the focus of a light beam with regard to a slit placed in front of the receiving apparatus (*e.g.*, a sound film) and thus the intensity of the light incident on it. Technical points in the construction are considered, and the advantages over the other available methods (Kerr-cell, etc.) are discussed. C. B. A.

3215. Optical Method for Determining Vapour Densities. H. A. Stuart and M. Weiss. *Phys. Zeits.* 33. *pp.* 302–304, *April* 1, 1932.—The authors assume that the molecular refraction $R = (n^2 - 1)M/(n^2 + 2)\rho$ is constant for any vapour. This is allowable, since it is found experimentally that in the change from gas to liquid, where the density increases a hundredfold, the molecular refraction changes in the most unfavourable cases by only a few units per cent.; so that it can be concluded that the alterations in the molecular refraction of a vapour between 0 and 2 atmospheres are certainly less than a thousandth part. Thus $(n^2 - 1)/(n^2 + 2)$ is directly proportional to the density ρ, and can be used as a measure of the density. The authors have made measurements with a Jamin interferential refractometer on air, CO_2 and ethyl ether, with satisfactory results. H. N. A.

3216. Optical Properties of Liquid Nitrobenzene in the Neighbourhood of its Transformation Point. M. Wolfke and S. Ziemecki. *Acta Physica Polonica,* 1. 1–2. *pp.* 271–279, 1932. *In French.*—The refractive index of liquid nitrobenzene, measured between 6·4° and 19° C. by three different methods, is found to remain continuous despite the enormous change in dielectric constant over the same range. A discontinuity in the molecular refraction occurs at 9·5° C., and is attributed to a change in molecular structure. The Raman spectrum remains unchanged over the same range of temperature. C. B. A.

3217. Effect of Chemical Substitutions on and Comparison of Dispersions of Magnetic Rotation and Birefringence in Derivatives of Naphthalene. C. Salceanu. *Comptes Rendus,* 194. *pp.* 1227–1229, *April* 11, 1932.—Gives values showing the relations between the magnetic rotations and those between the magnetic birefringences, for naphthalene and ten of its substitution products. The effects of the different additive groups follow the classification of Perkin for the magnetic rotations, and that of Cotton and Mouton for the magnetic birefringences. Measurements have also been made on the relations between the dispersion in the two phenomena. H. N. A.

3218. Effect of Solvents and Temperature on the Optical Rotation of Esters of Menthyl and Bornyl Hydrogen Xanthates, and on Menthyl and Bornyl Dixanthides. Irene M. McAlpine. *Chem. Soc., J. pp.* 1016–1022, *April,* 1932.—The specific rotations at six wave-lengths in the visible spectrum are given for the above compounds in a number of solvents at various temperatures. C. B. A.

3219. Application of the Optics of Scattering Media to the Illumination of the Atmosphere. P. Gruner. *Helv. Phys. Acta,* 5. 1. *pp.* 31–58, 1932. *In German.*—An earlier theory is briefly developed accounting for the illumination of the atmosphere in terms only of the primary scattering of sunlight by air molecules. On the basis of this, various calculations have been made giving the brightness of the sky vertically overhead for an ideal atmosphere, by Ramanathan for the particular case of sunset, and by Kleinert, in two different ways, for the period of twilight. Their results are compared and discussed, and it is shown that all three methods give comparable values when referred to the momentary zenith brightness, so that the general character of the brightness of the sky vertically overhead during twilight is correctly obtained. C. B. A.

3220. Transmission of Visible Light by Clouds of Particles. A. Kobayasi and D. Nukiyama. *Phys. Math. Soc., Japan, Proc.* 14. *pp.* 168–178, *April*, 1932. *In English.*—Transmission wave-length curves in the region 3000–5000 Å. have been obtained for clouds of NH_4Cl particles (radius 0·00937 cm.), H_2O and NH_4Cl–H_2O mixtures. For all densities of the cloud the curves for NH_4Cl exhibit a sharp maximum transmission at about 4580 Å., whilst transmission below 3100 Å. is negligible. With H_2O clouds there is a flat maximum at about 3600 Å. and a sharp and much greater maximum at 4780 Å.; the transmission-density curves for different wave-lengths are straight, nearly parallel, lines. H_2O–NH_4Cl clouds exhibit maximum transmission at 4400 Å. The results do not accord with Rayleigh's theory of scattering, but the condition that the size of the particles should be small compared with the wave-length used was not observed in the experiments. H. F. G.

3221. Molecular Scattering of Light in Solids. Part V. M. Leontowitsch and S. Mandelstam, Jr. *Zeits. f. Physik*, 75. 5–6. *pp.* 350–351, *April* 6, 1932.—Gives formulæ for the intensity of the light scattered by rock-salt, and by isotropic solids. The formula obtained for the latter differs from that of Gauss. The theory is compared with the experimental results. The agreement is not altogether satisfactory, and the authors consider that further observations are necessary. [For Part IV, see Abstract 1936 (1932).] H. N. A.

3222. Intensification of the Interference Colours of Thin Oxide Films. A. Güntherschulze and F. Keller. *Zeits. f. Physik*, 75. 9–10. *pp.* 597–598, *April* 29, 1932.—The intensity of the faint interference colours from oxide layers formed on Al anodes can be made comparable with that of the oxide layer on Ta if a transparent mirror of gold is evaporated on to the oxide surface. A similar effect is obtained on Sb surfaces. For some, but not all the metals investigated, a displacement of the interference colours is observed. [See Abstract 666 (1932).] C. B. A.

3223. Optical Measurement of Thickness. Interference Micrometer. H. Kreusler. *Zeits. f. techn. Physik*, 13. 5. *pp.* 241–243, 1932.—A wedge-shaped air film of constant length (10 cm.) is formed between two glass plates which are in contact at one end and separated at the other by the object (*e.g.*, a fine wire) whose thickness is required. Parallel interference fringes are obtained when the film is illuminated normally with parallel monochromatic light, and the thickness of the object can be deduced simply from the fringe-width, measured by means of a low-power travelling microscope. For thicknesses less than 0·02 mm. the accuracy obtainable is about 0·1 μ. C. B. A.

3224. Optical Determination of Changes in Thickness of Photo-elastic Models. V. Tesar. *Rev. d'Optique*, 11. *pp.* 97–104, *March*, 1932.—Measurements with polarised light, upon a loaded model, determine the directions and differences of the principal stresses. In order to determine completely the state of stress, measurements of the change in thickness of the models are required, and optical methods so far advocated demand accurately parallel surfaces to the model. By observing the interference fringes of equal thickness in a film of air between each surface of the model and a standard surface, the author is able to find these deformations with accuracy, even if the sides are inclined as much as 1°. The simple apparatus and method are described. J. P. A.

3225. Magnification of Binoculars. A. Nectoux. *Rev. d'Optique*, 11. *pp.* 115–122, *March*, 1932.—To secure binocular fusion of the retinal images obtained when using binoculars, the two optical systems must have the same magnification within a certain tolerance which is determined physiologically by the visual acuity. Assuming for the latter a value of 2 minutes of arc, the author finds that the permissible difference in the magnifications of the two optical systems must not exceed 0·5 % of the actual magnification. A tolerance of this magnitude is shown to be well within the powers of optical technicians. In addition, it is suggested that manufacturers should supply binoculars of a given magnification to within a tolerance of 2 %. A method for testing the magnification of binoculars is described. W. S. S.

3226. Magnification Method of Measuring Focal Length. J. S. Anderson. *Optical Soc., Trans.* 33. 2. *pp.* 55–62; *Disc.*, 62, 1931–1932.—The method described depends mainly on the determination of the distance between the two positions which the lens occupies corresponding to the reciprocal magnifications $-m$ and $-1/m$. Details of the method as applied to the measurement of the focal length of a small achromatic lens are given. The necessary precautions to be taken in making the measurements and the corrections to be applied when the curvature of field is taken into account are discussed. AUTHOR.

3227. New Bench for Testing Photographic Lenses. R. Kingslake. *J.O.S.A.* 22. *pp.* 207–222, *April*, 1932.—A distant point source is used, and the lens is mounted so that it can be rotated about a vertical axis through its second nodal point and set at any obliquity up to 60°, the image being observed with a microscope. This is arranged so that its focussing point is automatically in the ideal flat field of the lens, and it has the auxiliary motions necessary for testing telephoto lenses. Scales are provided for the direct measurement of astigmatism, curvature of field, distortion and oblique colour, while spherical and chromatic aberration can also be determined. The range of focal lengths is from 5 to 60 cm., with provision for direct measurement of equivalent focal length and back focus. The bench is self-contained with regard to all adjustments and scale-zero settings. The paper contains the theory of the design, and some criticisms. C. B. A.

3228. Methods of Focussing Projectors. J. M. Waldram. *Optical Soc., Trans.* 33. 1. *pp.* 26–28, 1932.—Description of a method for focussing trough reflectors and paraboloidal mirrors and for enabling the light source to be easily set at the optimum position in daylight. A. H.

3229. Rapid Spectrophotometry with Bi-Multiple Spectra and a New Type of Wedge Cell. F. Twyman, L. J. Spencer and A. Harvey. *Optical Soc., Trans.* 33. 2. *pp.* 37–53; *Disc.*, 54, 1931–1932.—A slit diaphragm for spectrographs is described by means of which the process of obtaining the absorption curves of liquids and solids is greatly facilitated. Its application to emission spectrography is considered. A new cell for absorption spectrography is also described. AUTHORS.

3230. Infra-Red Spectrometer of Large Aperture. H. M. Randall. *Rev. Sci. Instruments,* 3. *pp.* 196–200, *April,* 1932.—The mirror is a concave parabolic mirror of 36-in. focal length and of large aperture (24 in. dia.). The gratings are of the echellette type, 25 to 1000 lines to the inch and ruled on a surface 10 by 22 in. They are of a lead-tin alloy. The spectrometer is intended for use in the range of wave-lengths from 30 to 500 μ. J. H. A.

3231. Large Grating Spectrograph. A. L. Loomis and G. B. Kistiakowsky. *Rev. Sci. Instruments,* 3. *pp.* 201–205, *April,* 1932.—A description of the mounting and thermostating of a plane grating with a 40-ft. lens in a Littrow mounting. A. H.

3232. Photoelectric Amplification Photometer for Measurement of Faint Illuminations. G. Rougier. *Comptes Rendus,* 194. *pp.* 1319–1320, *April* 18, 1932.—The author describes an impersonal photometer which is very sensitive to differences of illumination so long as no call is made on the law of proportionality of the photoelectric current in the gradation of the light. It is enough to use a sufficiently stable standard light with which to gauge each measure. The standard light used is a pyrometric lamp whose filament is maintained by Ribaud's method. This photometer was first designed to measure the total light of the solar corona during an eclipse of the sun; it has also been used for measurement of the lunar light, of which more than 1700 observations were made in 1931. A. S. D. M.

3233. Visual Spectroscopic Method for Heterochromatic Photometry. L. S. Ornstein, J. G. Eymers and D. Vermeulen. *Zeits. f. Physik,* 75. 9–10. *pp.* 575–583, *April* 29, 1932.—The eye is placed at the exit slit of a monochromator, so that the observation is by Maxwellian view, and a lens placed at the entrance slit enables the observer to see in focus, (1) the filament of a pyrometer lamp, and (2) the surface, or the image of the surface, whose brightness is being studied. A setting is made by varying the current through the pyrometer lamp until the filament disappears. The apparatus is essentially a disappearing-filament spectropyrometer employing Maxwellian view. Applications to the following problems are described: relative intensity measurements at a given wave-length, measurements of reflectivity and absorption, determination of the intensity ratio of widely separated spectral lines with the aid of a standard lamp of known energy distribution, absolute intensity measurements, determination of the effective wave-length of colour filters in optical pyrometry, and photometry of lamps. W. S. S.

3234. C.I.E. Colorimetric Standards and their Use. T. Smith and J. Guild. *Optical Soc., Trans.* 33. 3. *pp.* 73–134, 1931–1932.—The new international standards, which define a standard observer, three standard illuminants, standard conditions of illuminating and viewing opaque specimens, a standard for evaluating the brightness factor of opaque specimens, and a standard trichromatic system for the expression of colour measurements, are stated and their origin explained. In addition to the numerical tables which are appended to the resolutions setting up these standards, there are given a table specifying the trichromatic coordinates for the standard observer of all spectral colours at wave-length intervals of 1 mμ, tables to facilitate the calculation of the standard coordinates and the brightness factor of a material illuminated by any one of the three standard illuminants from spectrophotometric measurements on the material, and a table giving the coordinates of some stimuli of special importance on the N.P.L. system, the standard system, and another system which occurs in the resolutions. Some new colorimetric terms are proposed, partly to avoid misinterpretation and partly to meet new needs. The theory of colour transformations, and points which arise in the application of the system and in the calibration of instruments, are discussed. AUTHORS.

3235. Optical Requirements of Aerial Mapping. I. C. Gardner. *Bureau of Standards, J. of Research,* 8. *pp.* 445–455, *April,* 1932.—A definition of stereoscopic parallax of an elevated point, appearing in two photographs taken from the same height, is given, involving only the angle of the lens and the height of the point above a datum plane. This function is considered in relation to the resolving power of the photographic plate. Optical distortion at the edge of the lens-field is unimportant when simply preparing a mosaic plan, but must be considered if topographic (*i.e.*, contoured) maps are required; the magnitude of this effect for a number of typical lenses is analysed. Lenses of the greatest possible angular field of view are desirable, consistent with the absence of distortion, and the possibilities of multiple-lens cameras are discussed. L. V. C.

3236. Motion Picture Projection in Relief and Colour. H. E. Ives. *J.O.S.A.* 22. *pp.* 191–198, *April,* 1932.—The method described is a combination of the Kodacolor scheme or chromolinoscope with the appropriate relief projection apparatus [see Abstract 3776 (1931)]. The record is made by a single exposure with an apparatus involving no moving parts and employing a large concave mirror for viewing the object through a wide angle. The complete apparatus is shown diagrammatically. The objections to the use of Kodacolor film on account of its small size and distortion due to expansion, contraction and warping are explained. These difficulties, it is suggested, could be overcome by making the picture for projection on glass. The method outlined is considered capable of being developed into a method of motion-picture projection in colour and relief. R. S. R.

3237. Polychrome Photography. F. E. Ives. *J.O.S.A.* 22. *pp.* 199–203, *April,* 1932.—A method of colour photography is described in which two negatives only are required. These are obtained by placing a panchromatic plate and a green-blue sensitive plate with their emulsions in contact and the glass side of the latter plate facing the lens of an ordinary plate camera; the exposure is made through a yellow filter. A surface dye stain on the emulsion of one of the plates is used to cut off all but the red-orange light from the panchromatic plate. Two prints are made, one being a " blue-toned " ordinary bromide paper print from the panchromatic negative, the other being a print on Eastman positive film from the blue-green sensitive plate. This second print is developed to a black image, then bleached to transparency and finally coloured in red and yellow tones by dyeing. The two prints are then mounted in register. Full details are given of the various processes and the manner of production of some of the colour effects is discussed. A. H.

3238. Photographic Plates for Use in Spectroscopy and Astronomy. C. E. K. Mees. *J.O.S.A.* 22. *pp.* 204–206, *April,* 1932. *Comm. No.* 487 *from the Kodak Research Lab.*—Adds to the methods already described [see Abstract 1608 (1932)] some further methods for the production of high green sensitive and high infra-red sensitive plates. A new sensitiser (xenocyanine) gives extraordinary sensitivity to the extreme infra-red, permitting the photography of spectra to beyond 11,000 Å. A. H.

3239. Elimination of Atmospheric Veiling in Photography. R. Mauge. *Soc. Franç. Phot. et Ciné. Bull.* 19. *pp.* 16–22, *Jan.,* 1932.—In the photography of a landscape the atmosphere is never perfectly transparent since it contains in suspension, dust, microscopic particles such as drops of water, etc. This atmospheric veil acts differently according to the wave-length of the light employed, the diffused light due to the particles being composed more especially of ultra-violet, violet and blue radiations. The present paper contains a study of various filters for eliminating arbitrary effects due to the veiling, and it is found that with infra-red radiations the atmosphere is no longer an obstacle for the photography of very distant objects. The paper is illustrated with data curves and comparative photographs. H. H. Ho.

3240. Hypersensitisation: Part I. Influence of Silver Ions on Sensitivity of Panchromatic Plates; Part II. Influence of Hydrogen Peroxide. J. I. Bokinik. *Zeits. f. wiss. Phot.* 30. *pp.* 322–333, *April,* 1932.—The hypersensitisation of fine-grained ordinary (diapositive) plates, before and after panchromatisation, and of phototechnical panchromatic plates is studied. The effect of silver nitrate on ordinary plates (unsensitised) is simply one of intensification in development due to adsorption of silver ions to the silver bromide grains. When, in addition, a sensitising dye is present, this reacts with silver ions to liberate metallic silver on the development centres, giving rise to true hypersensitisation. Schmieschek's process, employing both silver nitrate and hydrogen peroxide, is shown to involve a differential effect with panchromatic plates, the hypersensitising action of silver ions being more or less neutralised by the desensitising action of the peroxide. Hence this process applied to ordinary plates results solely in desensitising. Thallium nitrate gives results similar to those with silver nitrate. L. V. C.

3241. Photography of the Disturbance which Propagates Detonation to a Charge of Explosive. D. B. Gawthrop. *Frank. Inst., J.* 213. *pp.* 401–420, *April,* 1932.—A cartridge of explosive, the receiver, is exploded by the disturbance from the initiator. The paper describes experiments in which the " receiver " is photographed by the Schlieren method, where wave phenomena and gases are rendered visible by an optical device. Many of the photographs are reproduced. It is shown that the disturbance from the initiator (in a cellophane tube) consists of a plane discontinuous wave in the tube, followed closely by gases, spherical expanding waves outside the ruptured tube, and then the gaseous products of explosion. The receiver may be exploded by the plane wave. In general, the success or failure of propagated detonation depends upon the total energy of the blow struck by the disturbance from the initiator. There is a critical velocity of the shock wave which always propagates detonation, and a lower velocity which does not transfer detonation. However, shock waves with an intermediate velocity sometimes, with the aid of the gases, produce delayed explosions of the receiver. T. B.

3242. Desensitisers, Anti-Oxygens and Anti-Fluorescent Agents. E. Baur. *Zeits. f. phys. Chem. Abt.B.* **16. 6.** *pp.* **465–470,** *April,* **1932.**—It has long been known that activated molecules associated with photochemical effects are closely allied to, if not identical with, the activated molecules produced in dark reactions. From a theory of the author, it follows that the relation between the concentration of a desensitiser and the velocity of photolysis is given by $v = 1/\alpha + B(D)$, where v is the velocity as a percentage of the normal velocity, D is the concentration of the desensitiser and α is a constant. It is here shown by practical examples that the same equation holds for the action of anti-oxygens on oxidations and for the defluorescing action of the same substances. J. E.

3243. Photosensitising Action of Colourless Fluorescent Substances on the Flocculation of Colloidal Solutions. J. Bouchard. *Comptes Rendus,* **194.** *pp.* **1245–1246,** *April* **11, 1932.**—The results obtained previously for the accelerating action of substances fluorescent in visible light on the flocculation of salts by electrolytes [see Abstract **3999 (1931)**] have here been extended to fluorescent substances which are only excited by ultra-violet light. J. E.

3244. Anti-Stokes Terms in the Fluorescence of Iodine. I. I. Agarbiceanu. *Comptes Rendus,* **194.** *pp.* **1338–1340,** *April* **18, 1932.**—The fact that the series excited by the ray 5461 of Hg vapour in glass does not contain any anti-Stokes terms indicates that $\nu'' = n = p$, where ν'' is the quantum number of the non-excited state and n are the Mecke parameters; n enters into the formula giving the heads of the absorption bands, and p into that giving the fundamental series of fluorescence doublets. The present experiments gave the terms of order 0, 1, 3, 5 (Wood's notation) for 30 min. exposure and the anti-Stokes terms -1 and -2 for 48 hours' exposure. The existence of these anti-Stokes terms indicates that one cannot assign the quantum number $\nu'' = 0$ to the final vibration-level of order 0 ($\lambda = 5461$), but that the lowest unexcited state must be two quantum units below this at least. J. E.

3245. Resonance Spectrum of Iodine Vapour at High Temperature. E. Hirschlaff. *Zeits. f. Physik,* **75. 5–6.** *pp.* **325–337,** *April* **6, 1932.**—The resonance spectrum of iodine vapour at 600° C. excited by Hg 2537 Å has been measured and analysed. It is found that the McLennan bands change greatly at high temperature. It is also shown that surface fluorescence is due to the green and yellow lines of the excited resonance series. F. S.

3246. Wave-Length of Scattered Resonance Radiation. M. Minnaert. *Zeits. f. Astrophysik,* **4. 2.** *pp.* **153–158,** *March* **4, 1932.**—The frequency of scattered radiation is studied theoretically, for the case in which the incident radiation is close to, but not coincident with, the maximum of an absorption line. It is shown that on a variety of different views (which have been proposed before, but some are shown to need re-working) practically the same result is always obtained, namely, that the scattered frequency is exactly equal to the incident frequency.

R. d'E. A.

3247. Fluorescent Excitation of Mercury by the Resonance Frequency and by Lower Frequencies. Part III. (Lord) Rayleigh. *Roy Soc., Proc.* 135. *pp.* 617–627, *April,* 1932.—A method is described of observing the band spectrum of mercury, as produced by absorption of the atomic resonance line (core excitation) over a range of temperature with one photographic exposure. The modifications by heating are quite different at high and low pressures; the maximum 3300 being enormously enhanced at high pressures and the wing series, not observed before under core excitation, coming into view. At low pressure the 3300 is actually diminished in intensity by heating. The temperature behaviour indicates that the wing series and 3300 belong to one system, while the continuous emission near the resonance line and onwards belongs to another. Core excitation is able to excite Wood's series of bands 2345, 2338, etc., in spite of their considerably higher frequency. Moreover, their intensity is as the first power of the exciting intensity which excludes the possibility of excitation in stages. The forbidden line 2270 is recorded in fluorescence for the first time and proves the presence of large numbers of excited atoms in the metastable state 2^3P_2. [For Part II, see Abstract 112 (1932).] J. E.

3248. Triboluminescence in Mercury Vapour. S. de Walden. *Acta Physica Polonica,* 1. 1–2. *pp.* 223–236, 1932. *Summary in German.*—The triboluminescence of mercury vapour at the walls of the containing vessel associated with electric charges developed there has long been known. The object of this work was to investigate how the spectrum depends on the temperature. Using different vessels—of quartz, ordinary glass and pyrex glass, very carefully cleaned and freed from water, and exciting the luminescence by electrical heating—it is found that the nature of the walls has no effect on the spectrum, whose character is determined by the temperature and density of the vapour. For every wall material there appears to be a temperature above which triboluminescence ceases, a fact probably associated with the decrease of contact potential with temperature. The luminescence was examined spectrographically in the temperature region 90°–400° C. At the lower temperatures only lines are obtained, bands appearing first at 115° C. The bands increase in intensity with increasing temperature and density. The lines belong principally to the arc spectrum lower terms. Some lines appearing at 200°–300° C. belong to the first spark spectrum. The bands are those associated with the usual resonance fluorescence, becoming with increasing density a continuous band on the long-wave side of the resonance line 2537 Å. J. E.

3249. Quantum Theory of Transfers of Activation between Molecules of the Same Kind: Case of Fluorescent Solutions. F. Perrin. *Ann. de Physique,* 17. *pp.* 283–314, *April,* 1932.—The wave-mechanics theory is given of the interaction between two atoms of the same kind at large distances and of the mechanism of transfer of energy of activation. The asymptotic values of the energies of interaction are calculated and are shown to give the frequency of transfer. A comparison of the times of transfer at different distances with the duration of emission of fluorescence gives for stationary atoms a distance of transfer of a quarter of the wave-length of the emitted light, which is four times greater than the distance for atoms agitated by thermal energy. The theory is then extended to molecules of the same kind in solution, taking account of the effect of the solvent. Of the probability of finding one of the two molecules activated the excess above a half decreases exponentially with time, and the effect of the perturbations due to the solvent is further to reduce the distance of activation to 1/25 of the wave-length of the light emitted. J. E.

3250. Analysis of Ultra-Violet Emission of Earth-Alkali Phosphors. O. Schellenberg. *Ann. d. Physik,* 13. 3. *pp.* 249–264, *April* 20, 1932.—These experiments represent attempts to extend and confirm the series laws of Lenard and of Schmidt [see Abstract 1955 (1932)] for the emission and absorption bands of phosphors. The analysis of the complex bands obtained with earth-alkali phosphors, consisting of a number of overlapping single bands, is indirect. It is shown that the photometer curve of single bands such as can be obtained separated in CaS Bi indicates that the intensity distribution follows a Gaussian error law. Complex bands are then analysed from their photometer curves by the method of building up the photometer curve from Gaussian curves representing the individual bands. Tables are given showing the results of this analysis. The result of Schmidt is confirmed, that the emission bands are members of the same series as the absorption bands. The bands of CaO phosphors have the same absolute wave-lengths as those of CaS phosphors. The fact that in mixed phosphors (CaO and CaS) the bands observed are the same as those due to one or other of the bases alone without any shift indicates that the dielectric constant of the emitting centres is entirely characteristic of that centre and is unaffected by the presence of other material. J. E.

3251. Phosphors for Kathode-Ray Oscillographs. A. Schloemer. *Zeits. f. techn. Physik,* 13. 5. *pp.* 243–244, 1932.—From measurements of the emission of light by various phosphors it does not appear probable that much improvement can be obtained by the use of materials other than zinc sulphide phosphor, any improvement being certainly not so great as ten times. For use in kathode-ray oscillographs the fine-grained material should be employed, and water-glass is recommended as a binding material. A method is described for comparing the luminous properties of phosphors in a kathode-ray oscillograph, and a photograph is given showing the results of such a comparison for calcium tungstate, magnesium tungstate and three different samples of zinc sulphide. [See also Abstract 1688 (1931).] A. W.

3252. Luminosity of a Sodium Flame. T. W. Bonner. *Phys. Rev.* 40. *pp.* 105–111, *April* 1, 1932.—This paper contains an account of measurements of the variation of the luminosity of a sodium flame with the thickness of the flame and the concentration of the sodium salt solution sprayed into it. The reversal of the sodium lines by the layer of cool vapour at the front of the flame was eliminated by having no sodium in the front 3 cm. of the flame. An improved form of sprayer was used in which the level of the solution and its concentration remained constant. It was found that the luminosity is a function of the product of the thickness of the flame and the concentration of the sodium in it or of the mass *M* of sodium per sq. cm. This result agrees with the previous results of Gouy, H. A. Wilson and Locher, but not with the recent results of C. D. Child. The function of *M* is proportional to *M* when *M* is very small, but increases less rapidly than *M* when *M* is large. Measurements of the variation of the luminosity with the thickness at the centre of one of the *D* lines and at its edge showed, as expected, that the absorption at the centre is much greater than at the edge. AUTHOR.

3253. Crystal Radiation and Grain Boundary Radiation of Non-Metallic Substances (Oxides). F. Skaupy and H. Hoppe. *Zeits. f. techn. Physik*, 13. 5. *pp.* 226–228, 1932.—The emission of temperature radiation by polycrystalline substances may be associated with the absorption spectrum of the crystal lattice (crystal radiation) or with the radiational properties of the boundaries between the crystal grains (grain boundary radiation). Experimental studies of the absorptive power of various non-metallic polycrystalline substances (oxides, which are white at ordinary temperatures) showed that at high temperatures (1600° Abs.) there is a characteristic variation of absorptive power with wave-length and grain size, which is the same for all the substances studied. The conclusion drawn is that the temperature emission is due entirely to the grain boundaries. This is confirmed by measurements which show that single crystals of aluminium oxide have zero emissivity in the invisible region, whereas polycrystalline aluminium oxide of average grain size has a very high emissivity (temperature, 1500° Abs.). Further evidence in favour of the conclusion is obtained from measurements of the change of emissivity with wave-length, of mixtures of aluminium and chromium oxides in different proportions. The mode of origin of grain boundary radiation is discussed. W. S. S

3254. Absorption Spectra of Cyanogen and the Cyanogen Halides. R. B. Mooney and H. G. Reid. *Roy. Soc., Edinburgh, Proc.* 52. 2. *pp.* 152–158, 1932.—A study is made of the ultra-violet absorption spectra of C_2N_2, CNCl, CNBr and CNI. Measurements are given of the band heads of C_2N_2, and of the long wave-length limits of the continuous absorption regions due to the cyanogen halides. It is concluded that the most probable result of light absorption by these latter is the dissociation into an unexcited halogen atom and an excited cyanogen radical. A. H.

3255. Absorption Bands of Iodine and Tellurium. E. Hirschlaff. *Zeits. f. Physik*, 75. 5–6. *pp.* 315–324, *April* 6, 1932.—Measurements were made with a concave grating of 1·72 m. radius. The tellurium was heated in a hard glass tube to from 480° to 550° C. Photographs were taken in the second order spectrum and the predissociation found. In the case of iodine, about 50 bands in the neighbourhood of 8000 Å. were found and arranged. F. S.

3256. Absorption Spectra of Ethylene and Benzene Derivatives in the Near Infra-Red. R. Freymann. *Comptes Rendus*, 194. *pp.* 1471–1474, *April* 25, 1932.—The method used in previous work is again employed [see Abstract 1218 (1932)]. The absorption spectra studied are those of 10 derivatives of ethylene and 27 of benzene, over the range $0 \cdot 84\ \mu$ to $1 \cdot 16\ \mu$. Tables are given showing bands characteristic of certain groups such as CH with single and double bonds, OH, NH_2, etc. Groups which are respectively electrically negative and positive with respect to the benzene nucleus involve a displacement of bands towards the short and long wave-length sides respectively, as compared with the corresponding bands in the spectrum of benzene itself. A table is given of such displacements for two particular bands. N. D.

3257. Influence of Substitutions on the Characteristic Frequencies of Organic Compounds. G. Allard. *Comptes Rendus,* 194. *pp.* 1495–1498, *April* 25, 1932.—The effect of substitution on the characteristic frequencies of organic compounds is considered from the standpoint of the dipole theory. The energy of perturbation of a radical A by another B is calculated, and an expression is developed for the calculation of this energy from the electric moments of two dipoles. The expression is shown to change its sign when hydrogen is replaced by an organic radical. The results are applied to the substitution of Cl and Br in benzene. F. J. B.

3258. Rotational Vibration Bands of Water Vapour between 0·9 and 6·5 μ. P. Lueg and K. Hedfeld. *Zeits. f. Physik,* 75. 7–8. *pp.* 512–520, *April* 20, 1932.—The bands at 9050, 9400 and 11,300 Å were photographed and measured under high dispersion. From the constant differences between the vibration numbers found the three moments of inertia, $A = 3\cdot07 \times 10^{-40}$, $B = 2\cdot13 \times 10^{-40}$ and $C = 0\cdot97 \times 10^{-40}$, were determined, and from these all the dimensions of the molecule have been calculated. These values are in good agreement with those of previous investigations. H. N. A.

3259. Rotation-Oscillation Spectrum of Ammonia. P. Lueg and K. Hedfeld. *Zeits. f. Physik,* 75. 9–10. *pp.* 599–612, *April* 29, 1932.—The bands at 8800 Å. and 10,230 Å. were photographed with a 6·4 m. grating, using an absorption tube 5·80 m. long. 217 lines in the first band and 375 lines in the second were measured and the bands have been analysed. Comparison is made with the more important earlier measurements and dimensions of the NH_3 molecule are deduced. F. S.

3260. Infra-Red Spectra and Structure of Tautomeric Compounds. C. E. H. Bawn. *Chem. Soc., J. pp.* 1189–1198, *April,* 1932.—The infra-red absorption spectra of a number of tautomeric liquids, *viz.,* acetyl-acetone, benzoylacetone, acetic acid, acetone and ethyl acetoacetate and methyl acetoacetate have been determined in the region 2·8–6·3 μ. None of these compounds exhibit the bands due to the hydroxyl group which would be expected from their chemical structure; the reason may be either the entire absence of the hydroxyl group in the enolic form, or displacement of the band owing to the influence of the neighbouring C–C group. In the case of the carboxyl group the reason may be either the second of those mentioned, or the presence of an abnormal vibration of the hydrogen atom of the hydroxyl group. H. F. G.

3261. Transmission Spectra of Solid Dyes. W. C. Holmes and A. R. Peterson. *J. Phys. Chem.* 36. *p.* 1248–1254, *April,* 1932.—Transmission spectra are recorded for 32 solid azo, triphenylmethane and xanthene dyes. When the dyes are dissolved, the absorption bands are displaced in the direction of shorter wave-length. The data obtained indicate a high degree of molecular aggregation in the dry dyes. The measurements on these solid dyes show that basic and acid fuchsines and diamino derivatives of the triphenylmethane series in general undergo tautomeric modification in marked degree, the only difference from other triphenylmethane dyes being that different conditions are required to render the tautomerism manifest. With the solid violamines, however, no indication of more than one form is evident. An hypothesis is advanced which refers such tautomerism to valency rearrangements within the salt-forming amino group, these involving a tautomerism between trivalent and pentavalent bonding of the nitrogen atom. Among the classes of dyes referred to, the violamines are unique in that they do not permit of a pentavalent amino arrangement; they are, therefore, structurally incapable of tautomerism of the type postulated, and would be expected to prove stable on the basis of the hypothesis in question. T. H. P.

3262. Band Spectra of Chromium and Vanadium Oxides. W. F. C. Ferguson. *Bureau of Standards, J. of Research,* 8. *pp.* 381–384, *April,* 1932.—With the aid of much more extended measurements on the band heads due to chromium oxide (CrO) and to vanadium oxide (VO) more complete and precise vibrational analyses were made of these spectra. The new equations representing band heads are found to be:

$$\text{CrO}: \nu = 16{,}594\cdot 6 + 746\cdot 9\,(v' + \tfrac{1}{2}) - 7\cdot 9\,(v' + \tfrac{1}{2})^2 - 897\cdot 5\,(v'' + \tfrac{1}{2}) + 6\cdot 55\,(v'' + \tfrac{1}{2})^2;$$

$$\text{VO}: \nu = 17{,}498\cdot 8 + 864\cdot 9\,(v' + \tfrac{1}{2}) - 5\cdot 70\,(v' + \tfrac{1}{2})^2 - 1012\cdot 3\,(v'' + \tfrac{1}{2}) + 5\cdot 27\,(v'' + \tfrac{1}{2})^2.$$

Additional unassigned bands of VO are listed. AUTHOR.

3263. Band Spectra of Calcium Hydride. Part II. B. Grundström. *Zeits. f. Physik,* 75. 5–6. *pp.* 302–312, *April* 6, 1932.—The calcium hydride band system D, $^2\Sigma \rightarrow$ N, $^2\Sigma$ [see Abstract 3071 (1931)] has been further investigated. Details are given of the doublet system $\Delta\nu_{1,2}(K)$ and of certain series of satellites which appear at low rotation numbers. The band constants have been calculated. With the exception of the fundamental state the term separations of $\Delta\nu_{1,2}(K)$ show wide deviations from the normal, and it is suggested that this is due to the influence of the E,$^2\Pi$ state. H. F. G.

3264. Estimation of Temperature of Exploded Aluminium Vapour by Means of an AlH Emission Band. H. Nagashima. *Tokyo B.D. Sci. Reports, Sec.A.* 1. *pp.* 219–225, *April* 30, 1932.—The intensity distribution in the spectrum of an aluminium hydride band at λ4241, obtained when an aluminium wire of 0·4 mm. in diameter was exploded by short-circuiting an a.c. 200-volt source through it in hydrogen gas at atmospheric pressure, was measured with a registering microphotometer of the Moll type. Calculation based on the intensity distribution gives a value of about 2500° C. for the effective temperature of the AlH molecules existing in the exploded vapour. [See also Abstract 3084 (1931).] AUTHOR.

3265. Term Values in the Arc Spectrum of Selenium. R. C. Gibbs and J. E. Ruedy. *Phys. Rev.* 40. *pp.* 204–206, *April* 15, 1932.—A number of new lines in the spectrum of SeI have been observed and classified, and term values are given with respect to the lowest level of SeII, $4p^3\,{}^4S$. The first ionising potential of the selenium atom in its lowest energy state ($4p^4\,{}^3P_2$) is 78,659 ± 2 cm.$^{-1}$, or 9·70 volts. AUTHORS.

3266. Continuous Spectra Excited by Kathode Rays. Part VI. W. M. Cohn. *Zeits. f. Physik,* 75. 7–8. *pp.* 544–554, *April* 20, 1932.—Kathode rays are made to impinge on a thin foil septum between two highly evacuated enclosures. On the other side of the foil appeared a blue glow, unpolarised, possessing a continuous spectrum. The intensity distribution in the spectrum was similar to that observed in the blue glow formerly observed over solid surfaces, with a steeper fall towards the short waves [see Abstract 1229 and 2416 (1932)]. The spectrum of the glow was independent of the nature of the metal foil. The influence of current and voltage variations was investigated. Under no circumstances was the spectrum obtained in observable strength for wavelengths below 3000 Å. Simultaneously with the blue glow, X-rays were observed. A. C. M.

3267. Excitation of Spectra in Electric Vacuum Furnaces. R. Ritschl. *Ann. d. Physik,* 13. 3. *pp.* 337–357, *April* 20, 1932.—A description is given of a method based on the arrangement of Schüler and Wolf by which spectra of high luminosity can be excited in electric vacuum furnaces by production of a tension between the heating tube and an anode. In this system, which depends on electron collision, an excitation of the substances vaporised in the furnace by the smallest tensions is made possible. The kathode is a carbon tube insulated from the heating tube concentric with it and situated in its interior, which is only heated by radiation and shielded off from the potential fall along the heating tube. The anode is a carbon rod led into the kathode tube up to its half length, which at the same time serves as a director of the feed and is worked from the outside. Between anode and kathode discharges can be obtained of any desired small potential which excite the element vaporised in the kathode tube to the emission of spectra. The arrangement was used on the arc spectra of Cu, Au, Be and Al. The results were in agreement with the excitation tensions known from the analysis of these spectra. The arrangement avoids especially the errors easily arising in King's furnace method through the falling off of the potential along the heating tube. In some cases excitation maxima of lines could be observed. J. J. S.

3268. Molecular Spectra and Spectroscopic Analysis. Part IV. Scandium. G. Piccardi and A. Sberna. *Accad. Lincei, Atti,* 15. *pp.* 577–579, *April* 3, 1932.—The arc and spark spectra of scandium are not unduly complicated, but, as with other rare earth elements, it may be convenient sometimes to study the band spectrum of the monoxide ScO. This is formed by heating Sc_2O_3, and shows a system of bands, with origin in the orange, about 6036 Å., and another in the blue-green. The former system is generally seen in the arc spectrum of scandium, but is not easily registered photographically. As a method of quantitative analysis, the band spectrum can be used to estimate scandium with an accuracy of about 5 %, and it will detect as little as 0·005 %. [For Part III see Abstract 2857 (1932).] J. H. A.

3269. Theory of Complex Spectra. G. H. Shortley. *Phys. Rev.* 40. *pp.* 185–203, *April* 15, 1932.—A method is developed (similar to that for a configuration consisting of $\epsilon + \eta$ electrons) for calculating the electrostatic energy matrix for a configuration consisting of a closed shell minus ϵ plus η other electrons. The states are classified according to the quantum numbers of the "missing" and of the added electrons, and Slater's integral for each pair of electrons is calculated in the usual way except that a negative sign is attached to an integral connecting a "missing" with an added electron. It is shown that the matrices of magnetic interaction are identical in LS coupling for the two configurations mentioned above except for a reversal of sign of the spin-orbit coupling parameter corresponding to the almost closed shell. For two-electron spectra it is shown that the equivalence of the two electrons of the atom may be neglected when calculating the matrix of interaction in LS coupling by Johnson's method. Similar results obtain for the addition of an electron to an ionic multiplet. The method of calculation of the matrix of magnetic interaction between configurations for this method is considered, and it is shown that neglect of the equivalence of the electrons in case one of the configurations is composed of equivalent electrons leads to an error of a factor of $(2)^{\frac{1}{2}}$. There is no magnetic interaction between configurations which differ by more than the n value of one electron. This holds quite generally for any type of atom. A. H.

3270. Line Spectra of the Elements. Part I. Early Observations and Systems of Classification. [Bibliography. Part I. Papers Published during 1920–1931.] R. C. Gibbs. *Rev. Modern Physics*, 4. *pp.* 278–470, *April*, 1932.—After a brief historical outline of early work, the writer devotes a short explanatory section to each of the following topics: Balmer series, Rydberg formula, doublets in series spectra, principal series of sodium, diffuse series of cæsium, intensity relations for doublets, negative wave numbers, singlet and triplet series, spectra of singly ionised atoms, series of terms, determination of series limits, more precise series formulæ, Ritz combination principle, Bohr theory of the atom, unquantised orbits—continuous spectrum, spectrum of ionised helium. The Bibliography (about 150 pages) is classified under elements, but in addition a number of general references are given classified under years (1920–1931). It aims to include every important paper in the period covered. W. S. S.

3271. Theory of the Broadening of Spectral Lines and Collision Damping. V. Weisskopf. *Zeits. f. Physik*, 75. 5–6. *pp.* 287–301, *April* 6, 1932.—Mathematical. A new method is developed for calculating the broadening of spectral lines produced by absorption by the vapour of the substance producing the line. Smaller values are obtained than are assumed in previous theories. The change of frequency of an oscillation resulting from collision with an atom of the same or of a different substance is discussed, and an approximate method for calculating the optical cross-section is given. H. F. G.

3272. Proof of the Uniqueness of the Resolution of an Intensity Curve into its Components. E. Lonn. *Zeits. f. Physik*, 75. 5–6. *pp.* 348–349, *April* 6, 1932.—Proves that in the case of the intensity curves showing the fine structure of spectral lines, and in similar cases, the components of which the curves are built up are uniquely determined; in no case can a function of the form dealt with by Doetsch, that is to say, representing an observed intensity curve, be compounded in more than one way out of components. H. N. A.

3273. Hyperfine Structure of Mercury. K. Murakawa. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 357. *pp.* 97–100, *April*, 1932. *In English.*—Measurements of the structure of the zero lines of $\lambda\lambda$5461, 4358 and 4077 of HgI are made with the use of Lummer-Gehrcke plates and a new Geissler-tube exciting source. More accurate measurements of the structures of $\lambda\lambda$3984 and 6123 are also given. J. E. K.

3274. Hyperfine Structure and Selective Absorption. B. Venkatesachar. *Zeits. f. Physik,* 75. 9–10. *pp.* 676–678, *April* 29, 1932.—The hyperfine structure component + 0·790 cm.$^{-1}$ of the HgI line 5461 Å. suffers the least absorption under all excitation conditions. It is unlikely that this is caused by selective absorption as suggested by Lau and Reichenheim, since in that case the component − 0·278 cm.$^{-1}$, which has the same lower fine-structure level as + 0·790, should also not be absorbed. The selective absorption of the hyperfine structure components of CdI lines is investigated; it is found that the component + 0·106 cm.$^{-1}$ of the line 5086 Å. shows stronger selective absorption than component − 0·290 cm^{-1}. J. E. K.

3275. Hyperfine Structure of Lead Lines in the Region λ5000 to λ8000. Evidence for a Lead Isotope, Pb^{204}. H. Schüler and E. G. Jones. *Zeits. f. Physik,* 75. 9–10. *pp.* 563–569, *April* 29, 1932.—The hyperfine structures of 7 PbI lines and of 4 PbII lines in the region λ5000 to λ8000 are photographed and analysed into term schemes. In 4 lines an extra component is observed which, on account of its intensity and displaced position with respect to Pb^{208} and Pb^{206}, must be ascribed to a new lead isotope Pb^{204} having an abundance ratio of 1 %. This new isotope is isobaric with Hg^{204}. The relative position of the terms of Pb^{208} and Pb^{206} can be determined from the isotope displacement effect; the terms of Pb^{208} lie deeper than those of Pb^{206} for both the PbI and the PbII spectra. The phenomena typical of the isotope displacement effect which were observed for mercury are also found for lead. J. E. K.

3276. Nuclear Moments of Three Lead Isotopes. H. Kopfermann. *Zeits. f. Physik,* 75. 5–6. *pp.* 363–379, *April* 6, 1932.—The hyperfine structures of a large number of PbI and of some PbII lines are investigated. With the help of comparison photographs of uranium lead, Pb^{206}, and of thorium lead, Pb^{208}, the hyperfine structure components of each line can be correctly allocated to the three lead isotopes Pb^{206}, Pb^{207} and Pb^{208}. All lines of Pb^{206} and Pb^{208} are simple, whilst the lines of Pb^{207} usually possess several components. The components Pb^{206} and Pb^{208} are for most lines strongly displaced relatively to each other. Analysis of the structures shows that the nuclear moment of Pb^{207} is $\frac{1}{2}$ and of Pb^{206} and Pb^{208} is most probably zero. The centre of gravity of the terms of Pb^{207} lies between the terms of Pb^{206} and Pb^{208}, and in the case of PbII the deepest terms are those of the heaviest isotope. This is also very probably the case for PbI. J. E. K.

3277. Hydrogen Isotope of Mass 2 and its Concentration. H. C. Urey, F. G. Brickwedde and G. M. Murphy. *Phys. Rev.* 39. *pp.* 164–165, *Jan.* 1, *and* 40. *pp.* 1–15, *April* 1, 1932.—A search is made for possible isotopes of hydrogen. An isotope H^2 with mass number 2 is found to be present to the extent of one part in 4000 in ordinary hydrogen; no evidence of an isotope H^3 is found. With certain assumptions the vapour pressures of the three isotopic molecules H^{1}H^1, H^{1}H^2, H^{1}H^3 in equilibrium with their solids at the triple point for ordinary hydrogen are calculated to be in the ratio 1:0·37:0·29. The isotope was concentrated in three samples of gas by fractional evaporation of large quantities of liquid hydrogen, one sample being evaporated at atmospheric pressure and the other two at pressures just above the triple point. The samples and ordinary hydrogen were investigated for the visible atomic

Balmer series spectra of H^2 and H^3 in the second order of a 21-ft. grating having a dispersion of 1·31 Å. per mm. When with ordinary hydrogen the times of exposure required just to record the strong H^1 lines were increased 4000 times, very faint lines appeared at the calculated positions for the H^2 lines accompanying $H^1\beta$, $H^1\gamma$ and $H^1\delta$ on the short wave-length side and separated from them by between 1 and 2 Å. These lines were greatly enhanced relatively to the H^1 lines in the two samples obtained by evaporation near the triple point. The $H^2\alpha$ line was resolved into a close doublet with a separation agreeing with the observed separation for $H^1\alpha$. By comparing the times required just to record photographically the corresponding H^1 and H^2 lines the relative abundance of H^2 and H^1 in natural hydrogen is estimated to be about 1:4000, and in the concentrated samples about 1:800. As pointed out by Birge and Menzel, an isotope H^2 with an abundance of one part in 4000 is sufficient to explain the discrepancy between the chemical and mass spectrograph atomic weights of hydrogen. J. E. K.

3278. Copper Isotopes. Edna R. Bishop. *Phys. Rev.* 40. *pp.* 16–18, *April* 1, 1932.—The Allison magneto-optic method shows that copper has a third less abundant isotope of atomic weight less than 63. AUTHOR.

3279. Magnetic Resolution and Nuclear Moment of Rhenium. P. Zeeman, J. H. Gisolf and T. L. de Bruin. *K. Akad. Amsterdam, Proc.* 35. 1. *pp.* 2–9, 1932.—The arc spectrum of rhenium is excited by placing powdered rhenium in the positive pole of a vacuum copper arc, and is photographed in the third order of a 6-in. grating having 15,000 lines per in. and a radius of 21 ft. The hyperfine structure of the triplet λλ3452, 3460 and 3465 ($^6P_{3/2, 5/2, 7/2}-{}^6S_{5/2}$) is measured. The structures consist of four, five and six components respectively, all with decreasing intensities and separations towards longer wave-lengths. It is deduced from the interval rule that the nuclear moment of rhenium is $I = 5/2$. The Zeeman effect of this triplet is also investigated, and the splitting of the hyperfine structures is in agreement with the theoretical splitting for the moment $I = 5/2$. J. E. K.

3280. Zeeman Effect in the Arc Spectrum of Nickel. C. J. Bakker. *K. Akad. Amsterdam, Proc.* 35. 1. *pp.* 82–91, 1932.—The present paper records the Zeeman effect of lines in the nickel arc spectrum, classified mostly as combinations of the lower terms in the energy scheme. Anomalous *g*-values are found to occur which obey the Pauli *g*-sum rule. [See also Abstract 1051 (1930).] H. H. Ho.

3281. Zeeman Effect of Quadripole Lines of the Alkali Metals. E. Segrè and C. J. Bakker. *N. Cimento*, 9. *pp.* 76–83, *March*, 1932.—The best method for ascertaining whether " forbidden " lines are quadripole lines or arise in some other way is to investigate the Zeeman pattern of such lines and compare with the Rubinowicz theory of the Zeeman effect of quadripole lines. This was done for the first combinations $^2S-{}^2D$ of K and Na. The Zeeman patterns obtained agreed in the positions and intensities of the lines with the Rubinowicz theory. The measurements were made on the absorption lines, and, in addition to transverse and longitudinal observation, oblique observation was also employed, which enabled a characteristic feature of the theory to be verified, namely, that in oblique observation components with $\Delta m = 0$

appear, whereas these are absent in transverse or longitudinal observation. Certain points connected with the Paschen-Back effect for quadripole lines are brought out in the paper. W. S. S.

3282. Raman Effect of Polyatomic Molecules. J. Weigle. *Arch. des Sciences*, 14. *pp.* 82–95, *March–April*, 1932.—A description of the Raman effect, followed by examples of its application to the study of the structure of polyatomic molecules (in particular the triatomic molecules), especial prominence being given to the " valency forces " method of calculation. A. C. M.

3283. Raman Effect in Crystals. F. Rasetti. *N. Cimento*, 9. *pp.* 72–75, *March*, 1932.—The Raman effect was observed in gypsum, calcite, fluorite, quartz, anhydrite, barytes, aragonite, rock-salt and ice with the aid of the mercury line 2537 Å. New lines were found in the case of all the crystals tested, and the Raman spectrum was newly observed in fluorite and rock-salt. E. E. F. d'A.

3284. Raman Effect in Salt Solutions. A. Silveira. *Comptes Rendus*, 194. *pp.* 1336–1338, *April* 18, 1932.—The solvent was first subjected to the ultra-filtration method of Malfitano. Hg vapour light filtered through quinine sulphate was used as the source, thus cutting out 4046 and letting through 4358. Magnesium chloride, chlorate and nitrate have been used as the scattering agents. A frequency 1652 cm.$^{-1}$ with the chloride and 1655 cm.$^{-1}$ with the nitrate has been found. This is attributed to Mg-ion complex with water. Another frequency of 376 cm.$^{-1}$ was also found with the chloride and nitrate, doubtfully with the chlorate and certainly not with water. J. E.

3285. Raman Spectrum of Water. H. Hulubei. *Comptes Rendus*, 194. *pp.* 1474–1477, *April* 25, 1932.—The Raman spectrum of water, using the line 2536·52 Å. [see Abstract 3468 (1931)] shows a double band, with maxima at 3233 and 3443 cm.$^{-1}$, but with no trace of a third band [see Abstract 1550 (1931)]. Ten other bands (6747–10,944) were also measured, most of which disappear when a salt is added, indicating their probable connection with association in water. C. A. S.

3286. Raman Spectrum of Quinoline. G. B. Bonino and P. Cella. *Accad. Lincei, Atti*, 15. *pp.* 385–389, *March* 6, 1932.—The Raman spectrum of quinoline reveals a carbon-nitrogen bond, of the type $-C \rightleftarrows C-$. A. D.

3287. Raman Effect in Terpenes. G. B. Bonino and P. Cella. *Accad. d'Italia, Mem.* 3. 4. [41 *pp.*], 1932.—A continuation of previous work on hydrocarbons [see Abstract 1248 (1932)]. The substances studied, chiefly alcohols and ketones and all closely related to the terpenes, were pulegon, carvenone (carveol), β-thujone (tanacetone), carvol (carvone), menthone, fenchone, terpineol (mixture of α- and β-forms), cineol (eucalyptol), citral (*i.e.*, the α- and β-forms of geranial), citronellal, citronellol, linalol and geraniol. The line-shifts are grouped: (*a*) those due to the CH group, (*b*) those due to the double bond $C=C$ or $C=O$, and (*c*) the remainder. Group (*a*) has lines between 2800 and 3100 cm.$^{-1}$ and also 1400 to 1500 cm.$^{-1}$, and group (*b*) between 1600 and 1700 cm.$^{-1}$ The origins of the lines in group (*c*), which mostly have values beyond 900 cm.$^{-1}$, are discussed. J. H. A.

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3288. Raman Spectra of Piperidine, Ethyl Alcohol and Acetone. S. C. Sirkar. *Indian Journ. Phys.* 7. *pp.* 62–78, *April* 1, 1932.—The Raman spectra of piperidine, ethyl alcohol and acetone have been studied carefully with a view to record the faint lines and to compare these Raman spectra with the infra-red absorption curves for these substances. Solutions of *o*-cresolphthalein and uranine have been used as light filters in order to clean up the background in some regions of the spectrum and to assign the frequencies correctly. The wave-number shifts of the Raman lines observed are given. Piperidine has 14 new lines not recorded by previous workers, almost all of which are represented by maxima in the infra-red absorption curve. Ethyl alcohol shows two new lines 2709 and 2743, and in the case of acetone it is found that the line 2689 was assigned wrongly by previous workers as 925 excited by 4358 Å. AUTHOR.

3289. Polarisation of Raman Lines in Liquids. S. Bhagavantam. *Indian Journ. Phys.* 7. *pp.* 79–86, *April* 1, 1932.—The paper describes the results of a study of the polarisation of a few typical Raman lines in some liquids. The method adopted is to expose the two components of each line for different times so that they are recorded on the plate with equal densities. Correction is made for errors due to polarisation by oblique refraction at the prism surfaces, lack of transversality of the scattered beam and difference in the times of exposure of the two components. The intense line 992 in benzene shows a depolarisation of 7 %. The strong line in the series of tetrachlorides of carbon, silicon, titanium and tin arising from a symmetric expansion of these molecules exhibits a progressively increasing depolarisation, the actual values being 4 %, 11 %, 12 % and 16 % respectively. The depolarisation values of all the vibration lines studied in the present paper are found to lie within the range 0 to $\frac{6}{7}$. The rotational scattering appearing in the form of unresolved wings in carbon disulphide, benzene and thiophene is found to be depolarised to the extent of $\frac{6}{7}$. AUTHOR.

3290. Polarisation of Raman Lines of CS_2. S. Piénkowski. *Acta Physica Polonica*, 1. 1–2. *pp.* 87–91, 1932. *In French.*—The incident beam from a mercury-vapour lamp is split into two beams plane-polarised at right angles by a calcite slice, and these traverse the liquid. The light scattered perpendicularly is then analysed by a Wollaston prism before entering the slit of the spectrograph, so that in each exposure four spectra are obtained. Considering one direction of vibration (that perpendicular in the scattered beam to the electric vector in the incident beam), the 659 cm.$^{-1}$ lines are three times stronger than those belonging to 802 cm.$^{-1}$. The depolarisation factor for both lines was the same, and about 0·28. This is regarded as a confirmation of the linear structure of the CS_2 molecule. A. C. M.

3291. Separation of the ^2F Levels in Raman Spectra of CeIV. R. Brunetti and Z. Ollano. *Zeits. f. Physik*, 75. 5–6. *pp.* 415–416, *April* 6, 1932.—On Raman spectrograms of concentrated aqueous solutions of $CeCl_3$ and $Ce(NO_3)_3$ two frequency differences appear [1473 cm.$^{-1}$ for $Ce(NO_3)_3$ and 1640 cm.$^{-1}$ for $CeCl_3$], which probably arise from electron transitions between the ^2F levels of the Ce^{+3} ion. J. E. K.

3292. Refractive Index of Liquids for X-Rays. S. W. Smith. *Phys. Rev.* 40. *pp.* 156–164, *April* 15, 1932.—The refractive index for

X-rays was measured for several liquids by the method of total reflection. A monochromatic beam ($\lambda = 1{\cdot}537$ Å.) was obtained by using a copper target in the X-ray tube and by selectively reflecting the beam from a calcite crystal. This beam was, in turn, reflected at a grazing angle from a thin film of the liquid being studied, spread on a plane glass mirror. As the index of refraction for X-rays is less than unity, the beam will be totally reflected at angles smaller than the critical angle, a sudden reduction occurring in the intensity of the reflected beam at the critical angle. Photographs, taken while the mirror was being rotated, showed such an edge. A discussion is given of the effects on the microphotometer curves of the slit width of the microphotometer, the width of the crystal slit, the rotation of the mirror, and the finite width of the spectral line. From measurements of the curves, the values of δ, which is equal to $1 - n$, were obtained and compared with the values calculated by means of the simplified form of the Drude-Lorentz dispersion formula. The results are:—

Substance.	δ (experimental).	δ (theoretical)
Water	$3{\cdot}69 \times 10^{-6}$	$3{\cdot}53 \times 10^{-6}$
Butyl phthalate	$3{\cdot}57 \times 10^{-6}$	$3{\cdot}57 \times 10^{-6}$
Ethylene glycol	$4{\cdot}08 \times 10^{-6}$	$3{\cdot}88 \times 10^{-6}$
Triethanolamine	$3{\cdot}86 \times 10^{-6}$	$3{\cdot}91 \times 10^{-6}$
Glycerin	$4{\cdot}41 \times 10^{-6}$	$4{\cdot}34 \times 10^{-6}$
Glass	$8{\cdot}19 \times 10^{-6}$	—

AUTHOR.

3293. Photometer for New X-Ray Lines. W. Duane. *Nat. Acad. Sci., Proc.* 18. *pp.* 322–328, *April,* 1932.—Describes, with drawings and photographs, a new instrument for recording the new lines [see Abstract 2014 (1932)] in the K-series. A full discussion as to possible errors and their obviation is included. A. D.

3294. X-Ray Spectrometer with Stationary Ion Chamber. R. C. Hergenrother. *Physics,* 2. *pp.* 211–216, *April,* 1932.—A Bragg-type ionisation X-ray spectrometer which was designed for making quantitative measurements of integrated X-ray intensities reflected from crystals is described. The essential feature of the design is that the ionisation chamber is fixed in position, thus allowing a short fixed connection between ion chamber and electrometer (Hoffman). The ion chamber and X-ray tube used with the instrument are described. AUTHOR.

3295. X-Ray Spectra. A. W. Maue. *Ann. d. Physik,* 13. 2. *pp.* 161–190, *April* 8, 1932.—A theoretical paper concerned with applying wave mechanics to the production of X-rays by changes in electron velocities produced by a Coulomb field, and is a development of the theoretical work of Kramers. The early part of the paper is a useful collection of known formulæ with a critical comparison of the results of Kramers and wave mechanics as regards the intensity and polarisation of the emitted radiation. Provided the frequencies concerned are small compared with the critical frequencies of the atom, Kramers' results may be made to agree with those of wave mechanics. Differences between the two increase with the velocity of the electron, when the Kramers formulæ give intensities which are too large. J. E. R. C.

3296. Spectrography of X-Rays by Transmission of Non-Canalised Rays across a Curved Crystal. (Miss) Y. Cauchois. *Comptes Rendus,* 194. *pp.* 1479–1482, *April* 25, 1932.—The sharpness of definition is increased by increasing the radius of curvature, and decreasing the thickness of the crystal, and by a smaller aperture. Improvements on these lines, and the use of selenite in place of mica are described, enabling, *e.g.*, the principal lines in the L-fluorescence spectrum of platinum excited by 10 mA at 40 kV to be photographed in five hours. [See Abstract 2455 (1932).] C. A. S.

3297. X-Ray Spectra from Cross-Lattices. M. v. Laue. *Zeits. f. Krist.* 82. 1–2. *pp.* 127–141, *April,* 1932.—The known geometry of space-lattice spectra is adapted to the case of a cross-lattice. The problem considered is that of finding for a cross-lattice an analogy to a powder photograph. The result differs according as to whether or not the cross-lattice is transparent to the incident beam employed. The experiments of Sugiura on the reflection of protons are found to be capable, at least qualitatively, of explanation as interference phenomena due to cross-lattices. J. T.

3298. Reflection and Absorption of Long-Wave X-Rays. E. Dershem and M. Schein. *Zeits. f. Physik,* 75. 5–6. *pp.* 395–414, *April* 6, 1932.—Most of the subject matter of this paper has already appeared [see Abstract 3122 (1931)]. The relation between the atomic absorption coefficient μ_a and the atomic number Z is now given as $\mu_a = 1 \cdot 65 \times 10^{-23} Z^{4 \cdot 4}$ in the 44 Å. region. J. E. R. C.

3299. Relation between Chemical Constitution and K-Absorption Spectra. O. Stelling. *Zeits. f. phys. Chem.* 16. *Abt.B.* 4–5. *pp* 303–337, *April,* 1932.—Deals generally with the points which have to be attended to in observing the absorption edges. One of the main points is to use the right thickness for the absorbing layer to get the fine structure of the edge completely. It is shown how from the absorption spectrum the state of combination of chlorine, both in simple and complex compounds, can be deduced; and an attempt is made to explain the different types of spectrum theoretically. Certain complex chemical structural problems are discussed; stereochemical problems are dealt with, also the spectra of certain compounds containing Cl atoms which form Cl ions when the compound dissociates (ionogenic Cl). The paper concludes with details of the whole of the new experimental material. [See Abstract 499 (1931).] H. N. A.

3300. Satellites accompanying the X-Ray Diagram Line $K\beta_1$. F. R. Hirsh, Jr. *Phys. Rev.* 40. *pp.* 151–155, *April* 15, 1932.—Deodhar [see Abstract 3120 (1931)] has assumed the non-diagram lines $K\beta_3$, $K\beta'''$ and $K\eta$ to be satellites of the diagram line $K\alpha_1$, and not satellites of the diagram line $K\beta_1$ which they seem to accompany. His conclusion is due to the linearity of the satellite semi-Moseley graph, which results when $K\alpha_1$, and not $K\beta_1$, is considered to be the parent line of $K\beta_3$, $K\beta'''$ and $K\eta$. In the present note, the linearity of satellite data is shown to be entirely fortuitous. A study of the errors involved supports this conclusion. If we assume that these three non-diagram lines are really satellites of $K\beta_1$, the $\Delta\nu/R$ values which result are of the same order of magnitude as the $\Delta\nu/R$ values for other satellites. The conclusion is that $K\beta_3$, $K\beta'''$ and $K\eta$ are probably satellites of the diagram line $K\beta_1$. AUTHOR.

3301. Theory of Fine Structure in X-Ray Absorption Spectra. Parts II and III. R. de L. Kronig. *Zeits. f. Physik,* 75. 3–4. *pp.* 191–210, *March* 31, *and* 75. 7–8. *pp.* 468–475, *April* 20, 1932.—The theory developed in a previous paper [see Abstract 3846 (1931)] is elaborated. The secondary structure of the X-ray absorption edges has its origin in that the electrons released from the atoms by the X-ray quanta during the absorption process cannot traverse the crystal in a given direction with all energy values, but have an energy spectrum consisting of permitted and forbidden zones. It is now shown why finite variations in the absorption coefficient still remain, although the position of the zones depends on the direction, and the observed absorption bands represent the integrated effect of electrons propagated in all directions. The possibility of attributing the individual minima to the various reflections of the electrons at the grating planes, as for the lines of a Debye-Scherrer diagram, is also investigated. The application to experiment of the results obtained will appear in a later paper by Petersen. C. B. A.

3302. Sensitivity of Atomic Analysis by X-Rays. C. E. Eddy and T. H. Laby. *Roy. Soc., Proc.* 135. *pp.* 637–656, *April* 1, 1932.—In a previous paper [see Abstract 3353 (1929)] it was shown that the sensitivity of X-ray atomic analysis is about 0·1–1 part of a metallic element per million parts of alloy. This high sensitivity is now shown to be attainable provided proper experimental conditions are realised; when a poor vacuum exists in the X-ray tube, or when scattered radiation reaches the photographic plate the sensitivity may be considerably reduced. Factors influencing the sensitivity include (1) excess of voltage applied to the tube over that necessary to excite the lines sought; (2) the atomic number of the element in question; (3) selective and general absorption of the radiation; (4) blackening of the plate by continuous and scattered radiation and by chemical action; (5) the series spectra (K or L) used; and (6) the gas pressure. The following results are obtained: (1) 1 part of 29 Cu can be detected in 1,000,000 parts of 82 Pb; in an unfavourable case, 7 parts of 27 Co can be detected in 1,000,000 parts of 26 Fe; (3) lines in the K-series are about 20 times as intense as lines in the L-series; and (4) the presence of wax-vapours in the X-ray tube can reduce the sensitivity of the detection of 26 Cu in 30 Zn from 0·0007 % to about 0·1 %. A complete analysis is possible in the case of elements of atomic number exceeding 21. J. S. G. T.

3303. Atomic Factor for X-Rays in the Anomalous Dispersion Region. D. Coster and K. S. Knol. *Zeits. f. Physik,* 75. 5–6. *pp.* 340–347, *April* 6, 1932.—The investigation was undertaken in connection with the work described in a paper by Coster, Knol and Prins on the influence of the polarity of zinc blende on the intensity of X-ray reflection; and in the present paper the reflections by pure zinc have been dealt with. A method is given for finding theoretically the atomic factors in the neighbourhood of a K-absorption edge for finite angles of bending. It is shown that the effect of the anomalous dispersion on the atomic factor becomes greater when the angle of bending increases. This agrees with the experimental results obtained. It has also been found, in agreement with

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similar results by Glocker and Schäfer, that the course of the atomic factor curve on the short wave-length side of the K-edge is less steep than is predicted by the theory. H. N. A.

3304. X-Ray Scattering and Atomic Structure. E. O. Wollan. *Rev. Modern Physics,* 4. *pp.* 205–258, *April,* 1932.—A critical summary is given of the more important theoretical and experimental investigations on the intensity of scattered X-rays in relation to the determination of the structure factors and electron distribution of atoms. The more recent work on the scattering by gases and the diffuse scattering from crystals is discussed in greater detail. The close agreement between the theoretical structure curve calculated by Hartree [see Abstract 3345 (1929)] and those deduced experimentally by three independent methods [see Abstracts 844 (1929), 2709 (1931), and 139 (1932)] is emphasised. A full Bibliography is added. [See Abstract 4215 (1931).] C. A. S.

3305. Broadening of Compton Lines by Doppler Effect. J. W. M. DuMond, H. A. Kirkpatrick and L. Alden. *Phys. Rev.* 40. *pp.* 165–177, *April* 15, 1932.—Refers to a theory due to DuMond which explains the broadening of Compton lines as due to a variation of the Compton change introduced by the different momentum changes associated with different electrons in the scattering body (the electrons having a range of velocities), and quotes evidence, which is claimed to be conclusive, in support of it. The authors now consider the effect to be expected if the electron velocities, instead of having a random distribution, have directions of motion definitely related to the crystal structure. Ceylon graphite, which cleaves very easily and is strongly diamagnetically anisotropic, might be expected to show this effect and is examined with this end in view. The scattering bodies were made up by sticking together a large number of the small flakes in which Ceylon graphite occurs and were mounted in an arc so that the scattered radiation was brought to a focus. No effect was detectable, and the authors estimate that if an isolated class of electrons exists their number must be less than 5 % of the whole. J. E. R. C.

3306. Dependence of the Intensity Ratios of Secondary X-Rays upon the Incident Radiation. E. Alexander. *Zeits. f. Physik,* 75. 5–6. *pp.* 391–394, *April* 6, 1932.—The intensity relations between secondary X-ray lines emitted from silver are investigated by means of a Siegbahn vacuum spectrograph. The dependence of the intensity ratio $AgL\beta_2/AgL\beta_3$ upon the primary radiation was investigated, the primary radiation being the continuous spectrum from a tungsten antikathode. Average primary wave-lengths of 2·6 and 1·3 Å. were obtained by using potentials of 8 and 22 kV respectively, cutting out the softer components in the latter case by an aluminium foil 75 μ thick. The intensity ratio $AgL\beta_2/AgL\beta_3$ was 4:1 for a primary wave-length of 2·6 Å., and 1·33:1 for a primary wave-length of 1·3 Å. The relative absorption probability in the L level of silver as a function of the primary wave-length is calculated from Schur's formula and shown to agree with the change found in the intensity ratio $AgL\beta_2/AgL\beta_3$. For quantitive chemical analysis by secondary X-rays, since the intensity ratio depends upon the incident wave-length, and on the primary voltage if white radiation is used, the analysis must be made with the same primary voltage as was used to determine the intensity ratios of the lines to be compared, in case these do not originate from the corresponding level. J. E. R. C.

RADIOACTIVITY.

3307. Electrometers for Testing the Radioactivity of the Subsoil. G. Petrucci. *N. Cimento*, 9. *pp*. 63–67, *Feb.*, 1932.—Discusses the chief types of electrometer used for testing the radioactivity of the subsoil, including Wulf's wire electrometer and la Rosa's torsion electrometer, and finds the latter to be the more sensitive. Gives modifications of the torsion instrument to render it more suitable for field work. A. D.

3308. Valve-Amplifier Applied to Artificial Disintegration. L. Leprince-Ringuet. *Onde Élec.* 11. *pp*. 157–181, *April*, 1932.—The author gives an historical account of work upon artificial disintegration with a critical discussion of methods used for its investigation. A valve counter of the Greinacher type has been developed, and a description of it is given. Particular attention is applied to anti-microphonic devices. The first valve is a Philips electrometer valve, and this is followed by a six-valve amplifier of the resistance-capacity coupled type. Recording is effected with a Dubois oscillograph. The author discusses the results obtained from a study of artificial disintegration. The paper concludes with an account of recent work on cosmic radiation. J. E. R. C.

3309. Mobility of Radioactive Atoms on the Surface of Solid Bodies. H. Jedrzejowski. *Comptes Rendus*, 194. *pp*. 1340–1343, *April* 18, 1932.—A patch of polonium on platinum foil heated in a quartz tube to 600°–637° C. spreads increasingly over the whole surface (both sides) of the foil, only about one-tenth being evaporated and found on the quartz. On gold at 1000° there is very little spreading, evaporation predominating, and on mica at 440° almost exclusively evaporation. It is suggested that the polonium diffuses along the surface of the platinum [see Abstract 2512 (1929)]. C. A. S.

3310. Centrifuging Alkaline Solutions of Polonium. (Miss) C. Chamié and (Miss) A. Korvezee. *Comptes Rendus*, 194. *pp*. 1488–1490, *April* 25, 1932.—The maximum proportions of polonium centrifuged from aqueous solutions of ammonia (3×10^{-4} to 10 N), and sodium hydroxide (10^{-4} to 4 N), are 82 % from a solution of concentration 0·1 N, and 63 % from one of 0·007 N respectively. C. A. S.

3311. Fine Structure of α-Radiation of Radiothorium. S. Rosenblum and (Miss) C. Chamié. *Comptes Rendus*, 194. *pp*. 1154–1155, *April* 4, 1932.—Using the method previously described [see Abstract 1302 (1931)] the α-magnetic spectrum of radiothorium, prepared from $BaCl_2$ containing MsTh, shows the lines (figures give the velocities in cm. $\times 10^{-9}$/sec.): RdTh $1{\cdot}612_4$, strong; RdTh $1{\cdot}600_3$, medium; and a very weak line, α_x $1{\cdot}594_2$ of uncertain origin; and from an older preparation also ThA $1{\cdot}802_3$, Th $1{\cdot}736_0$ and ThX $1{\cdot}650_8$. C. A. S.

3312. Fine Structure of the Magnetic Spectrum of the α-Rays of Radioactinium. (Mme.) P. Curie and S. Rosenblum. *Comptes Rendus*, 194. *pp*. 1232–1235, *April* 11, 1932.—The observations were made by the method previously described by Rosenblum [see Abstract 1302 (1931)]. Some difficulty was caused by the gradual production of actinon, which produced a veil on the photographic plate. The following table shows the relations obtained between the energies of the α-rays and those of the γ-rays:

α-ray Lines.	Energy Differences between the Lines in ekV	Energies of γ-rays in kV.
1–3	60·0	61·4
1–4	195	191
1–5	295	300
2–3	33·6	31·5
2–6	309	300
3–6	275	282
4–5	100	101
5–6	41	43·7

The agreements are not so good as in the case of ThC. H. N. A.

3313. Retardation of the α-Rays of ThC′ in Air. G. Mano. *Comptes Rendus*, 194. *pp*. 1235–1237, *April* 11, 1932.—The α-rays from a linear source pass over a definite distance through zero magnetic field through a gas at known temperature and pressure; the final velocity is v. They then pass through a very thin screen (3 μ) of cellulose acetate in which the retardation is Δv, and penetrate through a very narrow slit into a high vacuum. Here they are deviated by a magnetic field and the deviation d is recorded on a photographic plate. A curve is given showing how the velocity varies for different thicknesses of air. It was found that if v_0 is the original velocity of the α-rays with the mean range in air 8·54 cm., v_1 the velocity of those with mean range 9·68 cm., and v_2 that of those with mean range 11·55 cm., then $v_1/v_0 = 1{\cdot}043$ and $v_2/v_0 = 1{\cdot}106$, if Geiger's law is exact. Correcting by means of a curve derived from the author's results, $v_1/v_0 = 1{\cdot}040$ and $v_2/v_0 = 1{\cdot}098$, which agree well with Rosenblum's latest results. H. N. A.

3314. Radioactivity of Potassium. P. Auger. *Comptes Rendus*, 194. *pp*. 1346–1347, *April* 18, 1932. Assuming K^{41} to consist of 10 helions, 1 neutron and 1 electron [see following Abstract], the emission of the neutron and electron would leave ordinary Ca^{40}, thus explaining the absence of the isotope Ca^{41}. A similar explanation would apply to rubidium and strontium. C. A. S.

3315. Existence of Neutrons and Constitution of Light Atomic Nuclei. F. Perrin. *Comptes Rendus*, 194. *pp*. 1343–1346, *April* 18, 1932.—The possibility of the very penetrating radiation emitted by beryllium under the influence of polonium [see Abstract 2469 (1932)] consisting of neutrons is deduced from Fournier's theories [see following Abstract], which are extended to suggest constitutions for several elements from helions (α-particles), protons and neutrons, and also the radiation emissible by each. It is further suggested that the ionising particles emitted by nitrogen atoms (which emit no neutrons) are demihelions, consisting of a neutron and a proton, and that the nucleus of the H^2 atom is a demihelion. C. A. S.

3316. Constitution of Atomic Nuclei. G. Fournier. *Comptes Rendus,* 194. *pp.* 1482–1483, *April* 25, 1932.—Atoms are built up of neutrons, demihelions (consisting of two protons and one electron—the nucleus of H^2) and helions, and disintegrate by loss of an electron (resulting in formation of an additional demihelion), neutron, demihelion or helion. [See Abstract 3643 (1930) and preceding Abstract.] C. A. S.

3317. Nature of the Penetrating Radiation from Light Nuclei Excited by α-Particles. Irène Curie and F. Joliot. *Comptes Rendus,* 194. *pp.* 1229–1232, *April* 11, 1932.—In their latest experiments the authors have studied the absorption in lead of the radiation emitted when Be is bombarded with α-rays from polonium. The ionisation chamber was filled in turn with A, N and He. From these experiments, and others made using the Wilson cloud chamber, they deduce that the radiation from the Be nuclei is complex, consisting in part of a γ-radiation, which is absorbed by the electrons owing to the Compton effect. It is emitted more or less equally in all directions, and its energy may reach $4 \times 10^6 eV$, which agrees with the approximate estimate of some millions of volts given by Rasetti. In addition to this, there is a very penetrating radiation which is absorbed by the projection of nuclei, and is emitted disymmetrically in relation to the incident α-particles. This radiation is supposed to consist of neutrons, forming a continuous spectrum limited on the high energy side at $4 \cdot 6 \times 10^6 eV$ with beryllium, and at $2 \cdot 6 \times 10^6 eV$ when boron is used. H. N. A.

3318. Radiation from Uranium Z. E. Walling. *Zeits. f. Physik,* 75. 7–8. *pp.* 425–432, *April* 20, 1932.—The absorption curve of radiations from a pure sample of uranium X is examined, precautions being taken to avoid β-rays scattered from the source holder. The absorption curve is not linear and is interpreted as indicating the presence of two β-ray groups and one γ-ray. The absorption coefficients of the two β-radiations are 53 and 173 cm.$^{-1}$ respectively in Al, and of the γ-radiation, $1 \cdot 1$ cm.$^{-1}$ in Pb. A determination of the decay of the γ-radiation gives $6 \cdot 7$ hours approximately as the half-value period, and it is deduced therefore that the γ-radiation arises from the uranium Z. An estimate of the ratio of the β-ray activities of uranium Z and uranium X is made, and this lies between $0 \cdot 15$ % and $0 \cdot 27$ % according to the amount of the filtration used. The branching ratio for uranium Z is also estimated. J. E. R. C.

3319. Tentative Theory of the β-Ray Emission of Radioactive Nuclei. A. Schidlof and H. Saini. *Helv. Phys. Acta,* 5. 2. *pp.* 73–91, 1932.—Abandoning the idea of free electrons in the nucleus, which leads to insuperable difficulties, the existence of pseudo-protons or α_1-particles is postulated, which are made up of an α-particle plus an electron, the combination being stable within the nucleus, and highly unstable outside. Gamow's idea of a potential barrier is adopted, and it can be shown that if a pseudo-proton escapes through the barrier it will dissociate into an α-particle and an electron, the former being recaptured by the nucleus, the latter being set free. The electron set free in this way constitutes the β-ray emission, and the energy of the β-ray will vary between zero and an upper limit, the precise value being determined by the place at which the dissociation occurred, although the position in question is itself indeterminate. The theory also interprets satisfactorily the fact that the Geiger-Nuttall law applies to β-ray emission, substituting the mean velocity of the β-rays for the unique velocity of the α-particles. The numerical aspects of the theory are worked out for the case of RaE. Collateral evidence for the hypotheses advanced is obtained from the existence of bifurcations of radioactive series. The author estimates that the mass of a pseudo-proton exceeds that of an α-particle by 0·0224 gm. per gramme-atom. W. S. S.

3320. Number of Electrons Ejected under Influence of Hard γ-Rays. H. Herszfinkiel. *Acta Physica Polonica*, 1. 1–2. *pp*. 237–248, 1932. *Summary in English.*—σ'_e being the total number of electrons liberated per quantum of γ-rays per electron of the absorbing element, its relative values for Fe, Ag and Pb, deduced by extrapolation from the results of Prelinger and Ederle [see Abstract 2452 (1923)], for the electronic emission due to γ-rays of RaC are as 1 : 1·24 : 1·68. The equilibrium corpuscular emissions due to γ-rays of RaC filtered through 4 cm. Pb, falling normally on plates of Al and Pb, are shown experimentally to be as 1·1 : 1. Those from Fe and Ag being approximately the same as from Pb, and values of μ_e, the absorption coefficient per electron of the electronic radiation being deduced by aid of Fournier's formula for the mass absorption coefficient [see Abstract 2633 (1926)] values of σ'_e for Al, Fe, Ag and Pb as 0·85 : 1·0 : 1·33 : 1·67 are obtained. σ'_e therefore probably varies much as σ_e, the absorption coefficient per electron of hard γ-rays, and there are more scattered electrons than explained by known absorption theories. If this is due to extra-nuclear electrons the theories are wrong if to the nucleus γ-rays must be able to effect disruption of a hitherto unknown type. C. A. S.

3321. Dependence of Ionisation by γ-Rays on Temperature. K. Wolff. *Zeits. f. Physik*, 75. 9–10. *pp*. 570–574, *April* 29, 1932.—The ionisation by γ-rays of a gas in a closed flask depends on the temperature. Under the conditions of this experiment the ion current in CO_2 increased by 1 % when the temperature was raised by 4° C; for the same increase of ion current in N_2 a temperature increase of 7° C was necessary. J. E. K.

3322. Spectrum of γ-Rays from Derivatives of Radiothorium. D. Skobelzyn. *Comptes Rendus*, 194. *pp*. 1486–1488, *April* 25, 1932.—Using the previously described method [see Abstracts 2563 (1927) and 1908 (1930)]; rays filtered through 30 mm. lead, and an angle of emission less than 10°, the γ-ray spectrum of radiothorium has been examined and the energy of the secondary Compton electrons determined. In addition to the chief maximum for 2650 kV, due to ThC″, smaller maxima occur for 2000 and 1650 kV, to which nothing corresponding was found by the photoelectric method. MsTh + RaTh shows a similar distribution, with a still smaller maximum for about 1550 kV. [See following Abstract.] C. A. S.

3323. Homogeneity of Filtered γ-Rays of Thorium C″ and Verification of the Klein-Nishina Formula. D. Skobelzyn. *Comptes Rendus*, 194. *pp*. 1568–1571, *May* 2, 1932.—The bearing of the softer rays, amounting to some 30 % of the total, discovered by the author [see preceding Abstract] on the verification of the Klein-Nishina formula as regards absorption of γ-rays from thorium C″, hitherto regarded as monochromatic [see Abstracts 1305, 1306, 4227 (1931)], is discussed, and the effect is shown to be small. The coefficients of total diffusion, σ_T (for Al), and the effective wave-lengths (in X) of the principal ray and of rays after filtration through 3 and 4 cm. Pb respectively are 0·098, 4·7; 0·105, 5·3; and 0·103, 5·1, correct to ±0·001. C. A. S.

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3324. Thermal Conductivity of Indium at Low Temperatures. W. J. de Haas and H. Bremmer. *K. Akad. Amsterdam, Proc.* 35. 2. *pp.* 131–136, 1932. *Commun. No.* 220*b from the Phys. Lab., Leiden.*—Indium shows the same general behaviour as lead and tin in that if the temperature is below the change point at which supra-conductivity sets in, but the resistance is artificially raised by means of a magnetic field, then the thermal conductivity is greater than in the absence of the magnetic field. There is a definite change in thermal conductivity at the transition point, even in the absence of a magnetic field. J. H. A.

3325. Thermal Conductivity of the Normal Primary Saturated Alcohols. M. Daniloff. *Am. Chem. Soc., J.* 54. *pp.* 1328–1332, *April,* 1932.—The thermal conductivities of seven normal primary saturated alcohols at 30°, 75° and 100° C. at atmospheric pressure are determined by means of a special form of radial heat flow calorimeter comprising a thin cylindrical sheath of liquid, as previously used by Bridgman, with certain improvements introduced by the author. The results obtained are summarised in a table, and are also shown graphically, the thermal conductivities of the alcohols at different temperatures being plotted against molecular weights. The curves show a marked minimum for *n*-hexyl alcohol, as for some other physical properties. The alcohols have a negative temperature coefficient of thermal conductivity, which has substantially the same value for all the alcohols investigated. T. B.

3326. Calorimetric Method of Measuring the Thermal Conductivity of a Bad Conductor. P. Vernotte. *Comptes Rendus,* 194. *pp.* 1462–1464, *April* 25, 1932.—The specimen is placed in contact with a metal of different temperature, and the quantity of heat which enters or leaves the former is measured by means of observations of the variation of the temperature of the metal with time. The metal consists of mercury placed in a Dewar flask, and the specimen is a plate of ebonite 10 mm. thick. The mercury is first cooled nearly to 0° C. by floating a beaker of ice in it, and, on removing the beaker, temperatures and times are noted. The ebonite, which has been kept in a constant temperature enclosure, is then immersed in the mercury, being supported so that there is as much mercury above as below it. A complicated theory, not given in the paper, allows the thermal conductivity to be calculated from the temperature-time curves and the water equivalents of the mercury and ebonite. N. D.

3327. Optical Investigation of the Accommodation Coefficient of Molecular Rotation of a Gas at Low Pressure. W. R. van Wijk. *Zeits. f. Physik,* 75. 9–10. *pp.* 584–596, *April* 29, 1932.—The intensity distribution was determined for the bands of the molecular spectrum of a gas at low pressure, confined between two concentric cylinders maintained at different temperatures. This intensity distribution determines the distribution of rotational energy among the gas molecules in the unexcited state. The molecules contained between the two cylinders consist of two streams, with different distributions of rotational energy, passing respectively from the high-temperature to the low-temperature cylinder and in the reverse direction. The change in the rotational energy distribution which occurs at the cylinder walls determines the accommodation coefficient, which is unity if the molecules after impact have the distribution corresponding to the temperature of the cylinder wall, and zero if the impact leaves the distribution unchanged. For hydrogen the results show a very small, but non-zero, accommodation coefficient. Measurements for nitrogen show that the condensation and re-evaporation theory of the accommodation effect is invalid unless it is assumed that the probability of condensation is less for molecules of high rotational energy. W. S. S.

3328. Accommodation Coefficient of Hydrogen; A Sensitive Detector of Surface Films. Katharine B. Blodgett and I. Langmuir. *Phys. Rev.* 40. *pp.* 78–104, *April* 1, 1932.—An equation is derived which gives the accommodation coefficient α of a gas striking a surface as the ratio of the observed heat loss from the surface to the theoretical heat loss that would be observed if all the gas molecules came to thermal equilibrium with the surface. The experiments show that at temperatures above 600° K. the values of α for hydrogen (0·20 mm. pressure) are greatly reduced by the presence of oxygen on the surface of the tungsten. Oxygen is inevitably produced in a tube when a tungsten filament is burned at $T > 1500°$ K. in hydrogen, as the atomic H thus formed dislodges oxygen from the walls even when the walls are cooled in liquid air. Hydrogen is absorbed on tungsten at $T < 1200°$ K. in two different forms, both of which reduce α from its value for bare tungsten. A film of the first type, which is adsorbed at $T < 600°$ K., changes over into the second type slowly at 600° K. and rapidly at 1100° K. The numerical values of α range from 0·537 for bare tungsten to 0·143 for tungsten with an adsorbed hydrogen film of the second type, and 0·094 for tungsten with an adsorbed film of oxygen. At $T < 200°$ K. an oxygen film forms which increases α to 0·422 at 150° K., provided that a small concentration of oxygen is continually present in the gas phase. AUTHORS.

3329. Periodic Radiometer for Eliminating Drifts. F. A. Firestone. *Rev. Sci. Instruments,* 3. *pp.* 163–188, *April,* 1932.—It is shown that while the Pfund resonance radiometer reduces the effect of drifts by a factor of several hundred, its advantage over the conventional Moll amplifying system as regards the reduction of the effect of Brownian motion on the accuracy of the readings is only about a factor of three for a resonance radiometer system requiring 140 sec. for a single observation. For a Moll system and a resonant system of equal times of observation, the Moll system is about twice as good as regards Brownian error in the readings. A resonance radiometer loses both its Brownian advantage and its ability to reduce drifts, when designed for a short time of response. A periodic radiometer particularly suitable for rapid recording is described, drifts being completely eliminated, while the time of response is only six sec. Two condensers in series with the amplifying circuit effectually stop all drifts while passing the periodic deflections. By averaging visually a considerable number of deflections, the accuracy of the resonance radiometer for equal reading time can be approached so that the same instrument may serve both for rapid exploration of spectra and more careful determination of detail. Infra-red spectra of high resolution have been successfully recorded from a grating spectrometer and, in amount of detail shown, closely approach the most carefully manually recorded curves. [See also Abstract 195 (1931).] AUTHOR.

3330. Construction of Thermoelements by Electrodeposition. H. Kersten and R. Schaffert. *Rev. Sci. Instruments*, 3. *pp.* 189–195, *April*, 1932.—Iron, cobalt, nickel, copper, gold, cadmium and brass have the property that they can be deposited electrolytically on stainless steel, and the deposit will peel off as a film by using suitable technique. This property is utilised to construct thermoelements. One-half of the stainless steel plate is covered with one metal, and the plate is then reversed and another metal deposited on the bare half, but slightly overlapping the first deposit. Thus a thin film is obtained, with a narrow junction where the one plated metal is joined to the other. Full details of the plating baths are given. J. H. A.

3331. New Form of Dilatometer. W. E. Prytherch. *Journ. Sci. Instruments*, 9. *pp.* 128–131, *April*, 1932.—The paper describes an apparatus for determining the temperature at which any abnormal change in length occurs in a body. An oscillating valve circuit is used, and the specimen is made to actuate the moving plate of a small condenser which constitutes part of the series grid capacity of the circuit. Small changes in this capacity bring about relatively large changes in the mean steady anode current of the valve. A continuous record of the anode current of the valve is made on a thread recorder, which also simultaneously records the temperature of the specimen. In this many abnormal length changes of the specimen can be correlated with temperature. AUTHOR.

3332. A.C. Thermostatic Control. J. B. Ramsey and T. A. Watson. *Indust. and Engin. Chem.* (*Analytical Edition*), 4. *pp.* 164–165, *April* 15, 1932.—A simple and effective circuit-breaker operated by a 110-volt a.c. is described. It has proved satisfactory for precise and extended temperature control for the past 3 years. The assembled circuit-breaker is illustrated in a sketch, and it is stated that no springs are involved; the life of all parts is practically unlimited; the space occupied is only about 0·5 cu. ft., and the current-breaker may therefore be attached conveniently to the side of the thermostat. T. B.

3333. High-Precision Thermostat. A. L. Ferguson, K. van Lente and R. Hitchens. *Indust. and Engin. Chem.* (*Analytical Edition*), 4. *pp.* 218–219, *April* 15, 1932.—Describes a thermostat maintaining a bath constant to within 0·01° C. for long periods, and to 0·001° C. for shorter periods. The regulator is of mercury in steel. J. H. A.

3334. Secular Rise of the Freezing Point of Joule's Thermometer (A). J. R. Ashworth. *Manchester Phil. Soc., Mem.* 75. *pp.* 37–42, 1930–1931.—A new determination of the freezing point of one of Joule's thermometers has been made, and a graph is given connecting rise of freezing point and time, which extends over the period 1844 to 1930. The total rise during this period was 0·642° C. L. G. C.

3335. Determination of True Temperature and Total Radiation of Luminous Gas Flames. H. C. Hottel and F. P. Broughton. *Indust. and Engin. Chem.* (*Analytical Edition*), 4. *pp.* 166–175, *April* 15, 1932.—The paper gives a method of determining the true temperature and the total emissivity of a luminous flame from a pair of "apparent" temperatures obtained with an optical pyrometer, using colour screens of two different effective wave-lengths in succession. These determinations are of great importance at present in the design of luminous-flame furnaces.

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The theory is given and tested experimentally on a series of six amyl-acetate flames in a row. The average deviation from the mean of the six predicted true temperatures was only 4° C. The results indicate that the two-colour pyrometer may also be used to determine the radiation from luminous flames, with an error of only about 5 %. T. B.

3336. Laboratory Furnace for High Temperatures. H. S. Booth and R. Ward. *Indust. and Engin. Chem.* (*Analytical Edition*), 4. *pp.* 199–200, *April* 15, 1932.—Describes a muffle furnace capable of maintaining temperatures constant to ±5° C. in the range 1000° to 1500° C. The heating elements are silicon-carbide resistance rods, known commercially as " Globar." It was noticed incidentally that the light emission of these rods increases with age. J. H. A.

3337. New Low Limit of Temperature. W. H. Keesom. *K. Akad. Amsterdam, Proc.* 35. 2. *pp.* 136–143, 1932. *Comm. No.* 219*a*, *from the Phys. Lab., Leiden.*—By rapid evaporation of liquid helium a temperature of 0·71° K. has been reached in a vessel having a volume of 5 c.c. This is to be compared with the value 0·82° K. attained by K. Onnes in 1921. J. H. A.

3338. Specific Heats of Solids at Temperatures Obtainable with Liquid Helium. Part IV. Atomic Heats of Tin and Zinc. W. H. Keesom and J. N. van den Ende. *K. Akad. Amsterdam, Proc.* 35. 2. *pp.* 143–155, 1932. *Comm. No.* 219*b from the Phys. Lab., Leiden.*—The specific heats were measured between 1·3° and 21° K., using resistance thermometers of constantan and also of phosphor-bronze. Tin becomes supraconducting at about 3·7° K., and its specific heat shows a discontinuity at approximately this temperature. No such discontinuity is found for the atomic heat of zinc, a metal which does not become supraconducting in the region studied. J. H. A.

3339. Specific Heats of Aqueous Solutions of LiCl, HCl and KOH. F. T. Gucker, Jr., and K. H. Schminke. *Am Chem. Soc., J.* 54. *pp.* 1358–1373, *April,* 1932.—The twin calorimeter method for determining heat capacities used in a previous investigation was further improved and modified [see Abstract 2427 (1928)]. The specific heats of LiCl, HCl and KOH were determined by means of the apparatus. The solutions were investigated from a concentration of 0·01 or 0·04 *N* to a concentration of 2 to 2·5 *N*. The accuracy of the method was about 0·01 %. The partial heat capacities of the solvent and solute were calculated. F. J. B.

3340. Influence of Electrolytes on the Specific Heat of Water. F. Urban. *J. Phys. Chem.* 36. *pp.* 1108–1122, *April,* 1932.—The specific heats of solutions of potassium chloride, tartrate, acetate and thiocyanate and also of barium chloride have been measured by the electrical method, using an adiabatic calorimeter. The results, in the main, cover the range of concentrations from 0·1 to 2 molal, at temperatures from 10° to 40° C. and are given to one part in 8000 or 9000. It is found that the order in which the ions decrease the heat capacity of the solvent water is similar to the order in which they affect the properties (swelling, viscosity, etc.) of lyotrophic colloids. It is suggested that the extent to which they cause the depolymerisation of the water is concerned in this series. J. H. A.

3341. Specific Heat (C_p) of Nitrogen. W. Weydanz. *Zeits. f. techn. Physik,* **13.** 5. *pp.* **233–237, 1932.**—An empirical equation for the specific volume is obtained from the volume measurements of Holborn and Otto, and from this an expression for the specific heat C_p is derived. Values of C_p are calculated for the pressure range 0 to 200 atmospheres, and for the temperature range $-100°$ to $+800°$ C. L. G. C.

3342. Investigation of γ in a Mixture of Gases. G. F. Barnes. *Acoustical Soc. of America, J.* **3.** *pp.* **579–590,** *April,* **1932.**—The velocity of ultrasonic vibrations was measured in gas mixtures, and from these data the ratio of the molecular heats of the mixture was calculated. The vibrations were produced by a quartz crystal driven by a thermionic oscillator. The method employed was essentially that used by G. W. Pierce [see Abstract 341 (1926)]. Mixtures of carbon dioxide and helium, air and helium, oxygen and helium, and nitrous oxide and helium were used. The molecular heat at constant pressure was taken from the International Critical Tables and the molecular heat at constant volume of the gas mixtures calculated. It was found that the ratio of the two molecular heats of the gas mixtures as determined by experiment agrees well with that obtained by calculation. AUTHOR.

3343. Two Liquid States. L. Meyer. *Zeits. f. Physik,* **75.** 5–6. *pp.* **421–423,** *April* **6, 1932.**—Remarks on Wolfke and Mazur's paper [see Abstract 2483 (1932)]. It does not seem probable that there is any analogy with the two liquid states of helium, but that there is an analogy with the transformations noted by Pauling [see Abstract 53 (1931)] in H-Cl compounds. A. D.

3344. Calculation of Normal Vapour Pressures from the Data of the Gas-Current Method, Particularly in the Case of Iodine. H. T. Gerry and L. J. Gillespie. *Phys. Rev.* **40.** *pp.* **269–280,** *April* **15, 1932.**—The gas-current method of determining the vapour pressure of slightly volatile substances is capable of a high degree of experimental precision and has often been applied. The question—whether the vapour pressure, so determined and subsequently corrected only for the Poynting effect, is accurately equal to the normal vapour pressure of the substance —has not hitherto been the subject of theoretical investigation. A method dependent on recent developments in the thermodynamic treatment of mixtures of real gases is here developed for calculating the normal vapour pressure from the data of the gas-current method. The suggested method requires data at varying total pressure for one inert gas at several temperatures and relatively accurate data at one atmosphere total pressure for two inert gases over the range of temperature. The one-atmosphere data for at least one of the inert gases must be of the precision desired on the normal vapour pressures. The method is applied to the case of the vapour pressure of solid iodine from 0° to 100° C., for which substance data exist which are suitable, though not obtained for the most appropriate choice of experimental conditions. The new corrections (for deviations from the laws of ideal gases) are found to be important numerically in the case of the best measurements. The errors inherent in the various methods of applying the gas-current method are briefly discussed. A graphic, empirical method is found liable to a characteristic source of error. AUTHORS.

3345. Pressure-Variation of the Heat-Function as a Direct Measure of van der Waals Forces. F. G. Keyes and S. C. Collins. *Nat. Acad. Sci., Proc.* 18. *pp.* 328–333, *April,* 1932.—The heat-function or thermodynamic potential is $\chi = E + pv$ (E = energy, p = pressure, v = volume). The coefficient $\partial\chi/\partial p$ is here shown to be a measure of the van der Waals forces. Starting with Gibbs' equation,

$$\left(\frac{\partial\chi}{\partial p}\right)_T = T\left(\frac{\partial S}{\partial p}\right)_T + v + \Sigma\mu_1\left(\frac{\partial m_1}{\partial p}\right)_T \quad . \quad . \quad . \quad . \quad . \quad (1),$$

where T, S, μ_1, m are the temperature, the entropy, the thermodynamic potential and the mass, and substituting $(\partial S/\partial p)_T = -(\partial v/\partial T)_p$, assuming the state of the system to be only a function of p and T, then with a single pure substance

$$\left(\frac{\partial\chi}{\partial p}\right)_T = v - T\left(\frac{\partial v}{\partial \tau}\right)_p = \left(\frac{\partial v\tau}{\partial \tau}\right)_p \quad . \quad . \quad . \quad . \quad . \quad (2),$$

where $\tau = T^{-1}$. On the other hand, from the Joule-Thomson coefficient, $(\partial T/\partial p) = \eta, = -(\partial\chi/\partial p)_T/(\partial\chi/\partial T)_p, = -(\partial\chi/\partial p)_T/c_p$, may be deduced the c_p values over a range of temperatures and pressures. Writing $(\partial\chi/\partial p)_T$ as C, and integrating (2),

$$\left[v_1\tau_1 - v_2\tau_2 = \int_{T_1}^{T_2} C d\tau \right] p,$$

whence, knowing C and the value of $v\tau$ along a vapour saturation curve, the volume v for a higher temperature T at constant pressure can be found. For an ideal gas $(\partial\chi/\partial p)_T$ is zero. However, for an ideal gas mixture having convertible components this coefficient would have a finite value. Thus, considering the simple case of the reaction $2A \longleftrightarrow A_2$, when α is used to represent the fraction of the A molecules converted to A_2, then for $\alpha \rightarrow 0$,

$$\left(\frac{\partial\chi}{\partial p}\right)_T = \frac{R\alpha}{2p}\left[\left(\frac{\partial f(T)}{\partial \tau}\right)_p - T\right],$$

where $\partial f(T)/\partial\tau$ is proportional to the heat, $-(\Delta v^\circ + \Sigma v_1 \int C v_1 dT)$ is required to convert 2A to A_2. An experimental value of $(\partial\chi/\partial p)_T$ would therefore determine α, if the heat of reaction were known, or the heat of reaction if α were given. This method promises, at least in those cases where the reaction velocity is great, to be a convenient and accurate method of determining the properties of such mixtures. Experimental method and apparatus are described. The method seems especially adapted to low-pressure and low-temperature experimentation. Further discussion is promised. A. D.

3346. Statistical Mechanics and the Second Law of Thermodynamics. P. W. Bridgman. *Science,* 75. *pp.* 419–428, *April* 22, 1932. —A review of recent tendencies concerning the nature of entropy and perpetual motion. The author deals with the limitations inherent in the use of models, especially statistical models. Eddington's views on the fundamental difference between mechanical and thermodynamical equations are discussed, and the significance attached thereto is considered unnecessary. The argument concludes with a treatment of cycles and fluctuations, and their importance for the universe. F. I. G. R.

SOUND.

3347. Velocity of Sound in N-Heptane Solutions. E. B. Wilson, Jr., and W. T. Richards. *J. Phys. Chem.* 36. *pp.* 1268–1270, *April,* 1932.—By means of a Hubbard and Loomis ionic interferometer measurements were made of the speed of sound in solutions of benzene and *n*-butyl alcohol in *n*-heptane at 25°, 35° and 50° C. over the entire concentration range. In both solutions the speed of sound is a regular and very similar function of both temperature and composition. W. H. Ge.

3348. Speed of Propagation of Ultrasonic Waves. P. T. Kao. *Ann. de Physique,* 17. *pp.* 315–370, *April,* 1932.—The original researches of C. W. Pierce [see Abstract 341 (1926)] on ultrasonic waves appeared to show a variation of velocity with amplitude and frequency. An improved acoustic interferometer of the Pierce type is here employed to re-investigate the problem. The reaction produced upon a quartz piezoelectric oscillator by the stationary-wave system between itself and a parallel glass reflector is analysed by its effect on the oscillatory circuit which drives the quartz. Curves having as ordinates the appropriate measure of reaction and as abscissæ the separation of quartz and reflector exhibit a double series of maxima. Those maxima which predominate near the quartz rapidly diminish, while the other maxima increase and then diminish slowly as the separation increases. The wave-length, derived from these observations, depends on the series employed. This accounts for the apparent variation of wave-length with distance from the quartz. At larger distances, and between 40 and 1000 kc., no variation in wave-length and no dispersion were observed. J. P. A.

3349. Multiple Peaks in Supersonic Interferometry. W. D. Hershberger. *Physics,* 2. *pp.* 269–273, *April,* 1932.—An improved circuit for use in supersonic interferometry in gases is described in which regeneration is under control and by the use of which the amplitude of the exciting e.m.f. may be varied between wide limits. Multiple peaks in the plate current maxima are observed, and several causes for such peaks, particularly the use of crystals having " parasitic " frequencies, are pointed out. Author.

3350. Doppler Effect with Piezoelectric Quartz. H. Müller and T. Kraefft. *Phys. Zeits.* 33. *pp.* 305–306, *April* 1, 1932.—Two piezoelectric quartz pieces vibrating in their ground frequencies were so arranged that the sound waves going out from their front surfaces overlapped. One piece, Q_1, was firmly fixed, vibrating in its characteristic frequency n_1; the second piece, Q_2, with characteristic frequency $n_2 < n_1$, was fixed to a pendulum. In the position of rest the front surfaces of the two quartz pieces stood at a distance of about 20 cm. parallel and facing each other. If the quartz Q_2 is now allowed to vibrate back and forward about its position of rest, then the pitch of the difference tone changes with the amplitude a or with the velocity v of the pendulum. The variations of the pitch of the note which an observer at rest observes in the moving source of sound may be calculated by the known formula $n' = n/(1 - v/c)$. J. J. S.

3351. Doppler Effect in Transversely Vibrating Cords. R. Serini. *Accad. Lincei, Atti,* 15. *pp.* 226–229, *Feb.* 7, 1932.—Generalised treatment of this mode of vibration, implying the Doppler problem in a complete form. A. D.

3352. Vibrations of a Circular Plate. R. C. Colwell. *Frank. Inst., J.* 213. *pp.* 373–380, *April,* 1932.—Thirty photographs are reproduced showing nodal figures on a Chladni plate operated by a valve oscillator [see Abstract 169 (1932)]. No figures consisting of radii alone have been discovered, whereas several figures are found which are not accounted for by Kirchhoff's theory. J. P. A.

3353. Forced Vibrations of a Circular Plate. W. Flügge. *Zeits. f. techn. Physik,* 13. 4. *pp.* 199–204, 1932.—The forced vibrations of an elastic plate are considered mathematically. The plate can be made to vibrate with any given frequency, and the resulting nodal figures, some of which are not centrally symmetrical, are explained. J. P. A.

3354. Elastic Measurements in Solid and Molten Metals. O. Stierstadt. *Engineer,* 153. *pp.* 55–56, *April* 29, 1932. *Metallwirtschaft, Jan.* 8 *and* 15, 1932.—The direction from which sounds proceed may be detected owing to the fact that the sound reaches the ear nearer the source slightly earlier than the more remote ear. This is applied to the measurement of the velocity of sound thus: Two microphones are suitably arranged in or on the medium examined so that they are displaced relatively to each other along the line of propagation of a sound impulse applied to the medium. A telephone is connected to each microphone and these telephones are thus excited at slightly different times. When the telephones are equidistant from the ears of the observer the sound seems to come from the direction of the telephone that is first excited. If the distances of the two telephones from the ears are adjusted until the sound seems to come from straight ahead, the speed of sound in the medium is calculable from the speed of sound in air, the distances of the telephones from the ears and the distance between the two microphones. This arrangement is used to measure the velocity of sound in rods of various material or in tubes filled with different fluids and hence to obtain the elastic constants of the substances examined. J. J. S.

3355. Acoustic Filters. E. Waetzmann and F. Noether. *Ann. d. Physik,* 13. 2. *pp.* 212–228, *April* 8, 1932.—Following a theoretical treatment of the action and properties of acoustic filters, the results are given of measurements of the transmission characteristics of high-pass and low-pass acoustic filters made up of connected tubes. The results, which were obtained by similar methods to those of Stewart [see Abstract 747 (1927)], in general confirm Stewart's theory. [See Abstract 263 (1930).] A. W.

3356. Acoustic Frequency Meter. E. Thielmann. *Zeits. f. techn. Physik,* 13. 4. *pp.* 204–205, 1932.—Coupled to a special motor is an electrical sound-generating circuit, which may be used to excite a loud-speaker. The frequency of the generated note may be read from a dial connected with the motor. If the motor is set running at its highest speed and switched off, it gradually runs down, and the resonance frequencies of the loud-speaker may be read on the dial in the process. J. P. A.

3357. Spontaneous Frequency Regulation. H. Martin. *Phys. Zeits.* 33. *pp.* 239–242, *March* 15, 1932.—A method is described by which a beam of light reflected by two tuning forks vibrating at right angles to one another falls on a photoelectric cell at a certain part of the vibration. It is so arranged that the cell works a relay, and by means of an electromagnet maintains a constant phase between the two forks. As only a small part of the Lissajous figure is intercepted by the cell, photographs can be taken. The phases can be altered by changing the resistance of the relay circuit. H. M. B.

3358. Theory of Hearing by Reception on Bone Conductors. G. v. Békésy. *Ann. d. Physik,* 13. 1. *pp.* 111–136, *March* 26, 1932.—An investigation was first made of the form of oscillation of the skull-cap for different frequencies, and then measurements were made of the minimum amplitude for audibility of vibrations received on bone structures. The results indicate that oscillations of amplitude 10^{-9} cm. should be easily perceived. Experiments were also made on reception on the bones of the skull with and without the ear passage stopped up. The results are discussed in relation to audition by conduction of sound through the air. A. W.

3359. Sound Emitted by Airscrews. C. F. B. Kemp. *Phys. Soc., Proc.* 44. *pp.* 151–162; *Disc.*, 163–165, *March,* 1932.—A condenser-microphone amplifier system has been employed to determine the intensities and directional properties of the first six harmonics in the sound of rotation of an airscrew operating at zero rate of advance and actuated by a silenced engine. The sound-energy associated with the frequencies considered has been found to be 18 watts, the fundamental (first harmonic) being responsible for 50 % of this, while the first three harmonics together contribute 90 %. Maximum intensity occurs from 15° to 30° behind the plane of rotation, and in this region the sound-output is particularly steady. Large intensity-fluctuations occur along the axis of the slip-stream. The intensity follows the inverse-square law of distance at points further than 200 ft. from the airscrew centre, a 2·4-power law holding approximately for nearer points. Kathode-ray oscillograms demonstrate the existence of frequencies of the order of 600 ∼, which are probably not components of the sound of rotation. The hypotheses of Lynam and Webb, as modified by Paris [see Abstract 2516 (1932)], are briefly discussed in relation to the results of experiment. AUTHOR.

3360. Echo Sounding from Aircraft. C. Florisson. *Comptes Rendus,* 194. *pp.* 1149–1150, *April* 4, 1932.—The author describes a h.f. echo sounding system for aircraft analogous to that used in the Langevin-Chilowsky system for ships. The use of a source of h.f. sound makes it possible to render the receiving circuit relatively insensitive to the l.f. (audible) sounds from the propellers and exhaust of the aircraft. The source proposed consists of an air-blown whistle placed at the apex of a conical reflector directed towards the ground. An extremely short signal (to permit of sounding near the ground) is sent out 40 times per min. by means of an electromagnetically-operated air valve. The receiver is a similar conical reflector connected by tubes to the ear of the observer. The latter has in front of him a chronometer movement in which the high-speed pointer revolves round the dial in about 0·2 sec. The sound emission occurs when the pointer passes through the zero position, the observer noting repeatedly the position of the pointer at the instant the echo arrives.

Soundings between 10 and 240 m. have been made from an aeroplane in this way—the apparatus being described as an acoustic altimeter.

A. B. W.

3361. Transverse Vibrations in Tubes. H. Kröncke. *Zeits. f. techn. Physik*, 13. 4. *pp*. 196–198, 1932.—By blowing a pipe of variable frequency just below it, a tube or strip of glass may be set into transverse vibrations of the chosen frequency. Nodes and antinodes are made visible if sand is lightly strewn along the tube or strip, and in this manner overtones beyond the twentieth may be excited. When the distance between the nodes is comparable with the diameter of the tube, the observed frequency is smaller than expected. Such tubes may be used for h.f. sound measurements. In thin-walled tubes it is possible to generate transverse vibrations in which the nodes are parallel to the axis of the tube. Tubes of this character can be employed as detectors of h.f. sound.

J. P. A.

3362. Natural Frequencies of Open Pipes. H. P. Leopold. *Zeits. f. techn. Physik*, 13. 5. *pp*. 222–223, 1932.—The formulæ given by Helmholtz, Rayleigh and Lorenz for the end correction applicable to open pipes are briefly discussed and compared. A. W.

3363. Tone Correction and Electric Music. F. Trautwein. *Zeits. f. techn. Physik*, 13. 5. *pp*. 244–246, 1932.—In electric music it is possible to introduce very fine modifications of tone in various ways. Electric oscillations corresponding closely to the types of oscillation given by musical instruments may be generated by impulsive excitation of systems capable of natural oscillation, thereby rendering possible the close imitation of musical sounds and the production of new sound colour. The opinion is expressed that the recognition of vocal sounds and sound colour by the human ear is closely connected with its physical limitation to resonance effects.

A. W.

3364. Power Requirements of Electric Carillons. A. N. Curtiss and I. Wolff. *I.R.E., Proc.* 20. *pp*. 626–646, *April*, 1932.—The authors use a microphone and amplifier (with ear-like response at two different intensity levels) to measure the sound intensity due to a set of bells at different distances from the tower. An air-maintained source of sound of reproducible intensity is described for use with the above. The audibility of the carillon under different noise conditions was investigated and a minimum intensity level for the carillon determined. For the purpose of measuring the noise levels the authors use either the microphone equipment described above or a slight modification of the tuning-fork method described by A. H. Davis, in which they arranged for a mechanical-striking mechanism to be used. Curves are drawn showing the relationship between the minimum sound intensity and the noise level, the power needed to produce this intensity at different distances being plotted as a function of distance. The measurements are applied to the practical case of electric carillons, *i.e.*, loud-speaker systems fed from large-power amplifiers.

J. E. R. C.

ELECTRICITY AND MAGNETISM.

ELECTROSTATICS, TERRESTRIAL ELECTRICITY AND MAGNETISM.

3365. Piezoelectric Constant of Zinc Blende. K. S. Knol. *K. Akad. Amsterdam, Proc.* 35. 1. *pp.* 99–106, 1932.—In connection with an investigation of the influence of polarity on the intensity of X-ray reflection in the case of zinc blende, a determination of the piezoelectric constant of this substance was made. The value given for this by v. d. Veen is $5{\cdot}24 \times 10^{-8}$ c.g.s. units, but it is pointed out that the value obtained from his results should be $\sqrt{3}$ times as large as this, which gives a result of $9{\cdot}08 \times 10^{-8}$ c.g.s. units. The value obtained from the work here described is $9{\cdot}70 \pm 0{\cdot}15 \times 10^{-8}$ c.g.s. units. At the same time the piezoelectric constant of quartz was measured and a value obtained about 1 % less than the best-known values of Curie and Röntgen. If this discrepancy has to be ascribed to some error in the apparatus, the value for zinc blende should be $9{\cdot}80 \times 10^{-8}$ c.g.s. units, which is nearly twice as large as the value hitherto quoted. A. W.

3366. Clausius-Mossotti Law. P. van Rysselberghe. *J. Phys. Chem.* 36. *pp.* 1152–1155, *April,* 1932.—A general expression of the Clausius-Mossotti law has been established, *viz.*, $(\epsilon - \epsilon_0) . M/(\epsilon + 2\epsilon_0)d = 4\pi N\alpha/3$, which is independent of the system of units and valid for all dielectrics which are perfect, homogeneous and isotropic. H. H. Ho.

3367. Determination of Dielectric Constants by an Oscillation Method. G. Mönch. *Zeits. f. phys. Chem.* 16. *Abt.B.* 6. *pp.* 438–442, *April,* 1932.—A method is described in detail for the determination of dielectric constants by means of h.f. oscillations. H. H. Ho.

3368. Dielectric Constants of Glasses in Dependence on Composition. F. Keller. *Zeits. f. techn. Physik,* 13. 5. *pp.* 237–239, 1932.—A series of glasses has been examined of the following compositions: 82 % (SiO_2 + metallic oxides) + 18 % Na_2O, wherein the SiO_2 has been replaced in increasing amounts by the following oxides, MgO, CaO, ZnO, BaO, PbO, B_2O_3, Al_2O_3 and Fe_2O_3; also 80 % (SiO_2 + alkali oxides), 20 % PbO (replacing SiO_2 by K_2O or Na_2O); and 65 % SiO_2, 15 % ($K_2O + Na_2O$), 20 % PbO (replacing K_2O by Na_2O). Curves are included which show dependence of dielectric constant upon composition, *viz.*: its increase with the content of metallic oxide in the glass corresponding to the greater dielectric constants of the metallic oxides compared with silica. H. H. Ho.

3369. Dielectric Constant, Resistance and Phase Angle of Ice. H. Wintsch. *Helv. Phys. Acta,* 5. 2. *pp.* 126–144, 1932. *In German.*—A bridge method was used to determine the equivalent pure capacity and parallel resistance of a condenser with ice as the dielectric, for frequencies from 50 to 800 ∼ and for temperatures of the ice from − 6° to − 50° C. In these ranges of temperature and frequency, the dielectric constant of ice varies in value from about 87 to about 8, and its specific resistance from about 350,000 to about 25,000 ohms. This pronounced " dispersion " effect for the dielectric constant is associated with the polar character of the molecules of ice. The experimental data can be satisfactorily reproduced, using a dispersion formula derived by Debye on the assumption that the molecules are polar and are orientated either parallel or antiparallel to the field direction, with an average life in one of the two possible states, equal to τ. τ is of the order 10^{-6} or 10^{-7} sec. An alternative explanation of the dispersion of the dielectric is to postulate a very small ordinary conductivity (ion conductivity). The experiments are unable to decide between the two viewpoints. W. S. S.

3370. Dielectric Constants of Thixotropic Systems and Orientated Layers. H. Kallmann and W. Kreidl. *Zeits. f. phys. Chem.* 159. *Abt.A.* 4. *pp.* 322–335, *April,* 1932.—Results are given of measurements of the dielectric constant of a vanadium pentoxide sol (both liquid and solid) rendered thixotropic by addition of a small proportion of NaCl for wave-lengths of about 50 m. Change from the liquid to the solid state is accompanied by a change of about 6 % in the dielectric constant. Hence, on thixotropic solidification, the water molecule is not markedly directed or solidified. The small difference in dielectric constant between the liquid and solid states may, therefore, depend on the fact that in the solution the rods of vanadium pentoxide can be directed by the electric field and thereby contribute to the dielectric constant, whereas in the solid state such directing effect is absent. If lauric or palmitic acid is allowed to solidify into thin layers (up to 10 or 20 μ) between metallic plates, the dielectric constant of the layers changes with the thickness, an increase of about 20 % being observed when the thickness is diminished from 60 μ. This alteration is doubtless due to orientation of the fatty acid molecules at the boundary surface. A non-polar substance such as diphenylamine, which exhibits no direction of the molecules at the boundary on X-ray investigation, shows no variation in dielectric constant with decrease in the thickness of the layer. T. H. P.

3371. Dielectric Constants of Dichlorethane, Dibromethane, Chlorobromethane and Diacetyl and the Phenomenon of Free Rotation. C. T. Zahn. *Phys. Rev.* 40. *pp.* 291–298, *April* 15, 1932.—Measurements of the dielectric constant of dichlorethane, recently published by the author [see Abstract 183 (1932)] indicate a considerable temperature variation of the electric moment, as predicted by various authors, because of the possibility of free rotation around the simple C–C bond, and a simultaneous dipole interaction between the two mutually rotating parts of the molecule. From these results one would predict a similar temperature variation in other symmetrically substituted ethanes containing large characteristic moments such as those of C–Cl, C–Br and C=O. In order to verify this supposition the present measurements were made on dibromethane, chlorobromethane, and diacetyl. The results prove to be similar to those for dichlorethane, and hence consistent with the predicted behaviour. The variations in electric moment ($\times 10^{18}$ c.g.s.e.s.u.) for the four substances are as follows: dichlorethane (previously published) 1·12–1·54 in the temperature interval 305°–544° K.; dibromethane 0·94–1·10 in the interval 339°–436° K.; chlorobromethane 1·09–1·28 in the interval 339°–436° K.; and diacetyl 1·25–1·48 in the interval 329°–504° K. A short discussion is finally given of the evidence for free rotation in ethane obtained from the specific heats of ethylene and ethane, and the possible importance of the hydrogen atoms in the interactions of the dichlorethane molecule. AUTHOR.

3372. Mechanism of Intermolecular Forces in Organic Molecules. G. Briegleb. *Zeits. f. phys. Chem.* 16. *Abt.B.* 4–5. *pp.* 249–275, *April*, 1932.—The Langevin-Born-Gans theory of the Kerr effect in gases is shown to be applicable under certain conditions to liquids, and the importance of the Kerr constant in problems of molecular association is investigated. After a short investigation of the relationship between molar refraction, absorption, polarisation, Kerr constants and intermolecular forces, data are given for the molar Kerr constants, dielectric constants, refractive indices and densities of solutions of ethyl ether, acetone, chloroform, benzene, CS_2, naphthalene, phenanthrene, diphenyl, toluene, *p*-dichlorbenzene and *p*-xylene in heptane, and in some cases in benzene and CCl_4. On the basis of a comparison of the molar anisotropies calculated from the Kerr constants of gases with those concentrations of the Kerr constants of the dissolved substances, conclusions are drawn with regard to the nature and mechanism of intermolecular forces in the condensed state. The experimental results allow of the recognition of four distinct types of molecular association. [See also following Abstract.]
C. B. A.

3373. Dielectric Measurements on Non-Polar Organic Compounds. G. Briegleb. *Zeits. f. Phys. Chem.* 16. *Abt.B.* 4–5. *pp.* 276–283, *April*, 1932.—The molar polarisations and refractions of mixtures of benzene, CCl_4, CS_2 and heptane are measured and the additivity of these properties in solutions tested. From the deviations from the mixture rule, conclusions are drawn with regard to the changes in electron, vibration and rotation frequencies produced by intermolecular forces. The dipole moments of benzene, CS_2, naphthalene, diphenyl, phenanthrene, *p*-dichlorbenzene and *p*-xylol deduced from the solution values, are all zero. [See also preceding Abstract.] C. B. A.

3374. Dipole Moments of the Naphthols. M. Puchalik. *Phys. Zeits.* 33. *pp.* 341–345, *April* 15, 1932.—The dipole moments of α- and β-naphthols have been determined for the first time by means of a resonance method, and are $1\cdot0$ and $1\cdot3 \times 10^{-18}$ e.s.u., respectively. This result is in general agreement with other data that the β-substituents of naphthalene, *e.g.*, the halogeno-naphthalenes, have greater moments than their α-isomers. It is noteworthy that the moment of α-naphthol is appreciably lower than that of phenol ($1\cdot6 \times 10^{-18}$ e.s.u.), while that of β-naphthol is lower than the moments of the alcohols, in striking contrast to the nitro- and halogeno-naphthalenes where the α-products have the same moment as the benzene analogues whereas the β-products approach the aliphatic compounds in their behaviour. These are important facts for a structural theory of the constitution of naphthalene. H. H. Ho.

3375. Dipole Moment and Constitution of Molecular Compounds of Titanium and Tin Tetrachloride in Benzene Solutions. H. Ulich, E. Hertel and W. Nespital. *Zeits. f. phys. Chem.* 17. *Abt. B.* 1. *pp.* 21–45, *April*, 1932.—Dielectric constants and cryoscopic molecular weight measurements are recorded for benzene solutions of $TiCl_4$.1 propionitrile, $TiCl_4$.2 propionitrile, $TiCl_4$.1 benzonitrile, $TiCl_4$.1 nitrobenzene, $SnCl_4$.2 propionitrile, $SnCl_4$.2 benzonitrile, $SnCl_4$.2 acetone, $SnCl_4$.2 acetophenone, $SnCl_4$.2 benzaldehyde, and $SnCl_4$.2 ethylether. Conclusions are drawn concerning the equilibrium in solution and dipole moments of the above complex molecules, and formulæ are derived for the polarisation of dissociating and associating products. H. H. Ho.

3376. Dielectric Tenacity of CCl_4 and CS_2. H. Eisler. *Zeits. f. techn. Physik*, 13. 4. *pp.* 189–191, 1932.—An account is given of the results of two series of researches undertaken to investigate the dielectric strength of resistance to electric discharge of CCl_4 and CS_2. J. J. S.

3377. Directional Character and Saturation of Electrical Properties of Dilute Sols. S. Komagata. *I.E.E., Japan, J.* 52. *pp.* 231–242, *March*, 1932. *English Abstract.*—The electrical properties of doubly-refracting sols depend on the direction and intensity of the applied electric field. These electrical characteristics are considered to be mainly due to the same cause as double refraction and their existence is evidenced in the character and non-isotropic property of the dispersion phase. This is discussed theoretically under the assumption that the shape of the dispersion phase is either a prolate or an oblate spheroid. A. W.

3378. Electrostriction of Benzene. M. Pauthenier and P. Delahaye. *Comptes Rendus*, 194. *pp.* 1465–1466, *April* 25, 1932.—The theory of Bruhat and Pauthenier is tested by means of measurements of the electrostriction of benzene [see Abstracts **1195** (1925) and **1084** (1926)]. The method is the same as that used with CCl_4. The experimental and theoretical values of the displacements of the fringes due to electrostriction are 0·12 and 0·21 respectively and of those due to double refraction 0·16 and 0·19 respectively. Considering various difficulties, the agreement is regarded as fairly satisfactory. N. D.

3379. Danger from Lightning in the Case of the Oak and Beech. B. Walter. *Phys. Zeits.* 33. *pp.* 306–307, *April* 1, 1932.—Attention is called to the fact that the assumption that a beech is under similar circumstances less visited by lightning than an oak is wrongly grounded in so far that statistics do not take account of the number of times different kinds of trees are struck by lightning, but only the number of trees injured by lightning. The beech, with its smooth outer bark, is less likely to be hurt by lightning than the oak, with its rough and rugged bark, and a difference in the liability to be struck by lightning does not appear to exist. J. J. S.

3380. Diurnal Variation of Atmospherics at Paris, 1928–31. Influence of Source and Propagation. R. Bureau. *Comptes Rendus*, 194. *pp.* 1368–1370, *April* 18, 1932.—The mean diurnal variation of atmospherics for each month at St. Cyr is shown by a series of curves. For nocturnal atmospherics the number decreases from September to March due to weakening and greater distance of the source, while the form of the maximum is determined by propagation phenomena. For afternoon atmospherics two maxima occur: (1) at 15 h, in the warm season, which disappears at sunset, its amplitude depending on the intensity and distance of the source, and the shape also on propagation; (2) at 16 h, which decreases towards midnight, and occurs only on stormy days, while the amplitude and form are due to relatively close sources. The action of cold front atmospherics depends on distance and when near the diurnal variation is often feeble, but when distant they have little effect on the mean curve, but considerable effect on individual curves. The activity of a near source is given, to a first approximation, by the height of the curve. The level of the minimum at sunrise gives a measure of the mean activity of cold front migrators, while that at sunset indicates the mean activity of quasi-stationary atoms. R. S. R.

3381. Investigations of the Aurora Borealis at Nordlys Observatory, Tromsø, 1929–1930. L. Harang and E. Tonsberg. *Geofysiske Publ.* 9. 5. [50 *pp.*], 1932.—Størmer's method of two parallactic photographs was used to determine the position of the auroræ in space, stations being used at Tromsø and Tennes, in Balsfjord. Quartz objectives were used in the cameras to reduce the exposure for work in the violet and ultra-violet. The method of computation to locate the auroral point is explained. Størmer's groups of auroræ are used, (1) diffuse arcs and bands, (2) draperies and arcs with ray structure, (3) rays, (4) pulsating surfaces, (5) diffuse luminous surfaces and (6) coronæ. In tables are collected the list of artificial stars used, times G.M.T. for each picture, coordinates of each auroral point and the height distribution of the lower borders of diffuse forms. The results of the height distribution are set out graphically and a comparison made with those obtained by Végard and Krogness and by Størmer. For (1) above, there is a close resemblance in all cases with maxima at 100 and 106 km., the maximum at 100 km. being predominant at Tromsø. For (2), the Tromsø results agree with Størmer's but exceed those of Végard and Krogness. Sunlit auroræ were also observed as draperies but without any marked ray-structure. R. S. R.

3382. New Proof of the Reversal of the Magnetic Inclination in Geological Ages. P. L. Mercanton. *Comptes Rendus*, 194. *pp.* 1371–1372, *April* 18, 1932.—Samples of magnetic, volcanic rocks were obtained from Western Scotland, the Faroe islands and Iceland, and the density, degree of magnetisation and inclination were found for each sample. There were difficulties in the time available in determining exact values, but in some cases a northern and in others a southern inclination was found. The results for the individual samples are given. R. S. R.

CURRENT ELECTRICITY, MAGNETISM AND ELECTROMAGNETISM.

3383. Resistance of a Charged Metallic Film. G. Polvani. *N. Cimento*, 9. *pp.* 69–71, *March*, 1932.—In a paper by Pierucci [see Abstract 2957 (1932)], it was stated that a charged conducting film has an additional conductivity according to the number of conducting electrons added to it, but that the additional conductivity is only two-thirds of the amount expected from theory. Now the author shows that this discrepancy can be removed by applying instead of the classical theory of metallic conduction the theory of wave mechanics and Fermi's statistics. At very low temperatures the increase would be three times the increase at ordinary temperatures. E. E. F. d'A.

3384. Conductivity of Black Paper. L. Grillet. *Comptes Rendus*, 194. *pp.* 1464–1465, *April* 25, 1932.—The electric resistance of a type of black paper used by artists is measured. For a piece of dimensions 12 cm. × 5 cm. × 0·1 mm. the resistance along the long axis is 10^5 ohms. The resistance diminishes as the temperature increases. In constant temperature and hygrometric conditions it is possible to construct stable, high, constant or variable resistances. It is proposed to use a sheet of this paper as a two-dimensional conductor in which to trace equipotential lines in place of the sheet of metal used in the well-known laboratory experiment. The paper, being a bad conductor, will allow various forms of electrodes to be used. N. D.

3385. Conductivity of Loaded Piezoelectric Quartz. F. Seidl. *Zeits. f. Physik*, 75. 7–8. *pp.* 488–503, *April* 20, 1932.—It has been found that when a load is applied to piezoelectric quartz the electrical conductivity is increased. In connection with the investigation the elastic after-effect has been determined, in so far as it may be a source of error in the measurements of conductivity. The piezoelectric constant was determined as 0·0677, which agrees extremely well with the values measured by J. and P. Curie. The homogeneity of the specimens tested was determined by means of radiations from radioactive sources. The investigations were carried out at 21° C. H. N. A.

3386. Conductivity of Oils at Low Temperatures. A. Gemant. *Zeits. f. Physik*, 75. 9–10. *pp.* 613–621, *April* 29, 1932.—The conductivity of mineral oils has been measured for temperatures ranging between − 60° C. and room-temperature. A d.c. amplifier and a special design of condenser of comparatively high capacity (1800 cm. in air) are used for this purpose. The logarithmic conductivity-temperature curves lead the author to draw the following conclusions: (1) The absolute height of the curves makes it possible to compare with considerable accuracy the insulating qualities of the oils (transformer, motor and lubricating oils were used); (2) the comparatively marked flattening of the curves below − 10° C. appears to indicate that the viscous oils undergo a sort of solidification resembling that of glasses at their transformation point (about 400° C.); (3) in the case of viscous oils a *negative* temperature coefficient of the conductivity is observed. The author suggests an explanation of this last result. H. L. B.

3387. Current Conduction with High Fields in Dielectric Liquids. A. Nikuradse. *Arch. f. Elektrot.* 26. *pp.* 250–260, *April* 21, 1932.—With a view to gaining knowledge of the mechanism of current conduction of dielectric liquids with high field strengths the dependence of the current on the distance apart of the electrodes at constant field strength was studied. In unpurified liquids no definite law was observed: at times the current J increases at constant strength of field if the electrode distance δ is increased, at other times it remains constant and sometimes it falls off with further rise of δ. In pure liquids with clean electrodes, J increases with δ. The increase of the distance apart of the electrodes from 0·01 to 0·5 mm. gave in a special case an exponential rise of J. This value $J = i \cdot e^{k\delta}$ depends on ionisation by collision. From it the ionisation number k was obtained. The equation requires that log J increases linearly with δ. In some cases a deviation from this relation was observed: log J increased more slowly than linearly with δ. It was found that the current increased proportionally to the magnitude of the surface of the electrodes. J. J. S.

3388. Change of Conductivity of Ferromagnetics in Magnetic Fields. O. Stierstadt. *Zeits. f. techn. Physik*, 13. 2. *pp.* 65–71; 13. 3. *pp.* 105–111, *and* 13. 4. *pp.* 161–165, 1932.—The relative change of resistance of nickel in a longitudinal field consists at first of an increase with the field strength. When the field is diminished to zero, there is a remanence of resistance change, and a negative field is required to reduce the resistance to its initial value. Further increase of the negative field again causes increase of resistance. Thereafter, on diminishing the field and completing the cycle the remanence and coercive force effects are repeated, and the resistance change passes through a hysteresis cycle. The effect with iron is similar, and the course of the curve depends on the previous treatment of the metal and other physical conditions. For moderate longitudinal fields the effect is positive, and for strong transversal fields negative at room-temperature. It is considered that for both directions of the field the normal effect is an increase of resistance, but that the increase of spontaneous magnetisation below the Curie point causes a diminution of resistance. When the temperature is sufficiently low, the resistance change in all metals, including ferromagnetics, is positive, both for longitudinal and transverse fields. G. E. A.

3389. Supraconductivity of Hg-Cd Alloys. W. J. de Haas and J. de Boer. *K. Akad. Amsterdam, Proc.* 35. 2. *pp.* 128–131, 1932. *Comm. No.* 220*a from the Phys. Lab., Leiden.*—Measurements of the resistance of mercury-cadmium alloys at liquid helium temperatures show the great influence of the crystal lattice on the phenomena of supraconductivity. J. H. A.

3390. Theory of Rectification. L. Nordheim. *Zeits. f. Physik,* 75. 7–8. *pp.* 434–441, *April* 20, 1932.—A wave-mechanical theory of rectification produced by a point contact between a metal and a semiconductor is given and discussed. The paper includes a comprehensive Bibliography. J. E. R. C.

3391. Establishment of an Absolute Scale for Thermoelectric Force. G. Borelius, W. H. Keesom, C. H. Johansson and J. O. Linde. *K. Akad. Amsterdam, Proc.* 35. 1. *pp.* 10–14, 1932.—The authors introduce $e_{\text{abs.}} = \int_0^T \sigma/T \, . \, dT$, where σ is the Thomson coefficient, as the thermoelectric force per degree of a metal in the absolute thermoelectric scale. They calculate this quantity for tin, lead and the silver-alloy normal used, on the basis of measurements of the thermoelectric forces and of the Thomson coefficient, and on the assumption that $\sigma = 0$ in the supraconducting state, and of an interpolation for tin between 7·2 and 20° K. J. E. K.

3392. Thermoelectric Forces Down to Temperatures Obtainable with Liquid or Solid Hydrogen and with Liquid Helium. G. Borelius, W. H. Keesom, C. H. Johansson and J. O. Linde. *K. Akad. Amsterdam, Proc.* 35. 1. *pp.* 15–33, 1932.—Thermoelectric forces against a silver-alloy normal were measured down to the temperatures obtainable with liquid or solid hydrogen for Ag and an alloy of Ag with Au and for Au with small quantities of Fe, Co, Ni, Mn, Cr or Ti respectively. The thermoelectric forces were similarly measured down to the temperatures obtainable with liquid helium for Pt and for alloys of Cu with a small percentage of Fe. For these alloys the thermoelectric force per degree near absolute zero is proportional to T. With increasing temperatures it reaches a maximum and then decreases. The maximum is displaced towards higher temperatures for increasing concentration of Fe. The combination Au + 1 % Co against Ag + 1 % Au is recommended as a sensitive thermoelement for the temperature range of liquid hydrogen and liquid helium. J. E. K.

3393. Glow Discharge in Pure Mercury Vapour. F. Köppen. *Zeits. f. Physik,* 75. 9–10. *pp.* 654–670, *April* 29, 1932.—The author has

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determined in the glow discharge of mercury the normal kathode fall of potential, the normal current density and the width of the dark spaces with kathodes of Al, Ni, Fe, Ag, W, Cu, Mo, Hg and C; he has also determined the anomalous potential fall at the kathode for Al, Ag, Fe and C in mercury vapour. With the exception of Cu, the normal kathode fall is found to be proportional to the work of escape of the material in question, the greatest deviation being 6 %. The anomalous kathode fall may be represented for potentials from 700 to 1000 volts by the expression $j = C_2 \,.\, V^{C_1}$, where C_1 is constant to some extent only for iron over a definite range of pressure of the mercury vapour. H. L. B.

3394. Electrodeless Discharges. J. S. Townsend. *Phil. Mag.* 13. *pp.* 745–759, *April*, 1932.—In previous papers on h.f. discharges it has been shown that the theory given to explain the uniform positive column in d.c. discharges also explains the uniform luminous column of h.f. discharges in cylindrical tubes. The theory may be applied in general to various other types of discharge, such as electrodeless discharges in spherical bulbs, provided the pressure of the gas is within certain limits. Certain simplifying assumptions are made, and use is made of the results of previous investigations. The formulæ and conclusions arrived at are discussed in their relation to the theory of radiation. A. W.

3395. Arc Discharge Not Obtained in Pure Argon Gas. G. E. Doan and J. L. Myer. *Phys. Rev.* 40. *pp.* 36–39, *April* 1, 1932.—Between very pure iron electrodes in an argon atmosphere of fairly good purity the low-voltage arc was easily maintained. When the argon was rigorously purified the arc could not be struck even with moderate potentials. Although the present theories do not require it, the normal arc discharge does not appear to depend upon the presence of chemically active atoms or molecules, either in the gas or on the electrodes. Various hypotheses are presented. AUTHORS.

3396. Translatory Electron Groups at the Kathode in a Self-Maintained Arc Discharge. M. Wehrli and P. Bächtiger. *Helv. Phys. Acta*, 5. 2. *pp.* 106–125, *April*, 1932. *In German.*—By measuring the current to an auxiliary probe electrode, placed near to the kathode in an arc discharge between tungsten electrodes, for various pressures of the nitrogen gas filling the apparatus and for various potentials of the probe electrode, the existence of a primary translatory electron group with volt-velocity corresponding to the kathode fall was established. The current to the probe electrode, which is composed of positive ions and electrons produced by collisions as well as the primary translatory electrons, is analysed, and with the aid of theoretical considerations the current characteristic of the probe electrode is computed. Important quantitative data concerning elastic and inelastic electron collisions in the self-maintained arc discharge are obtained in this way. W. S. S.

3397. Mechanism of the Positive Column in Monatomic Gases. R. Seeliger. *Phys. Zeits.* 33. *pp.* 273–294, *April* 1, *and pp.* 313–327, *April* 15, 1932.—A comprehensive discussion of the phenomena of the positive column and the carriers for this part of the discharge is followed by a description of experimental methods and results regarding potential gradients, electron temperatures, recombination, wall currents, etc. The second part deals with the contracted discharge, temperature measurements in the positive column, and concludes with a discussion of the balance of energy. A. W.

3398. Energy Contributions in the Positive Column of Inert Gases. K. Sommermeyer. *Ann. d. Physik*, 13. 3. *pp.* 315–336, *April* 20, 1932.—The amount E_v of the energy which is transformed into heat in the body of the column, the amount E_s of the radiant energy which passes through the glass wall, and the amount E_0 of the energy which produces heat at or in the wall of the tube are determined experimentally for helium, neon and argon. Under " clean " conditions E_v amounts, at a pressure of 1 mm. of mercury, to about 20 % of the work done by the current in the case of all three gases. It is practically independent of the current strength and increases with increasing pressure. The value of E_s varies from 5 % to 30 % according to the current strength, pressure and type of gas. A calculation is made of the transference of momentum due to elastic electron collisions. The theoretical and experimental results are compared and discussed. H. L. B.

3399. Observation of Neutral H_3 in Canal Rays. R. Conrad. *Zeits. f. Physik*, 75. 7–8. *pp.* 504–511, *April* 20, 1932.—Previous attempts to obtain evidence of the existence of neutral H_3 have been fruitless. The author has found, however, that in canal rays in which H_3^+ ions exist, these ions change into neutral H_3, from time to time, over a certain length of path. The canal ray is passed between two electrodes, and when an electrostatic field is produced between these the H_3^+ ions are bent to one side, so that they no longer pass through the original slit. The H_3 molecules are not deflected and, though they are quickly reconverted into H_3^+ ions, these having passed out of the electrostatic field proceed in the original direction, and pass out through the slit. The lower limit found for the life of the H_3 molecule is 3×10^{-8} sec. H. N. A.

3400. Emission of Radiation from Retarded Protons and Fast Electrons. O. Scherzer. *Ann. d. Physik*, 13. 2. *pp.* 137–160, *April* 8, 1932.—Calculations on this subject by Sommerfeld [see Abstract 575 (1932)] are elaborated and discussed. It is shown that the orthogonal system used by Sommerfeld is complete if it is assumed that the polar proper-functions form a complete system. The author discusses the influence of mass and sign of the charge on the emission of radiation. The intensity of the X-radiation to be expected owing to the retardation of the protons by the stripped nucleus is calculated. The direction distribution of the retarded electrons is computed without the correction due to relativity. The paper concludes with a statement of the results obtained when the problem is treated relativistically. H. L. B.

3401. Neutralising Cross-Section of Hydrogen Molecules with respect to Slow Protons. H. Bartels. *Ann. d. Physik*, 13. 3. *pp.* 373–376, *April* 20, 1932.—The neutralising cross-section (*Umladungsquerschnitt*) of hydrogen molecules with respect to H^+ canal rays is measured over the range of velocities 4 to 16 kV. This cross-section passes through a maximum at about 7 kV. The results link up well with those of Goldmann and earlier measurements by the author. H. L. B.

3402. Scattering of Slow Electrons by Neutral Atoms. E. Feenberg. *Phys. Rev.* 40. *pp.* 40–54, *April* 1, 1932.—An equation is obtained for the elastic scattering of an electron by an atom with N-electrons in the outer shell. The treatment of the problem is based on a wave-function anti-symmetric in the space-spin coordinates of all the electrons. The author also discusses exchange interference and criticises its application by Oppenheimer to furnish a qualitative explanation of the Ramsauer–Townsend effect. The tentative conclusion is reached that exchange interference is of minor importance in the complete explanation of this effect. H. L. B.

3403. Polarisation of a Beam of Electrons Reflected by a Crystal. J. Thibaud, J. J. Trillat and T. v. Hirsch. *Comptes Rendus,* 194. *pp.* 1223–1225, *April* 11, 1932.—The authors attempted to obtain evidence of the polarisation of a beam of electrons, predicted under certain conditions by Mott. A plane crystalline reflecting surface was used as polariser; it consisted of a gold or platinum foil, adjusted so as to throw intense diffraction patches, resembling those of a Laue diagram, from a gold monocrystal on to a zinc sulphide screen. A second screen was placed 104 mm. behind the first, and could be adjusted inside the common vacuum, so that it received only the electrons from one of the above patches. The analyser, which was placed over the opening in the second screen, was a gold foil about 60 mμ in thickness, and gave a series of sharp rings on a photographic plate placed beyond it. Examined visually, these rings appeared to be symmetrical, so that the polarisation caused by crystalline reflection with small angles must be only feeble. Even when the intensities in the photograph were determined photometrically only a very small lack of symmetry was found, which was in the same direction as that predicted by Mott's theory, but no greater than might be produced by other causes. In any case Mott's theory strictly applies only to electrons scattered at angles of about 90°. H. N. A.

3404. Free Electrons in Ionised Gases in a Magnetic Field. T. V. Ionescu and C. Mihul. *Comptes Rendus,* 194. *pp.* 1330–1332, *April* 18, 1932.—Previous work is extended [see Abstract 2089 (1932)]. The present paper is concerned with air and hydrogen, at pressures between 10^{-5} and $1 \cdot 5 \times 10^{-1}$ mm. Hg. Measurements of the number of collisions of free electrons with gaseous molecules and of the mean velocity of agitation of the electrons, with and without magnetic fields, are made, and tables of results are given. It appears that the effective diameters of the molecules taking part in such collisions vary with the pressure and are of the order of magnitude given by classical theory. The values of the mean velocities of agitation of the electrons are close to those calculated by Langmuir's method. N. D.

3405. Equations of Motion of Accelerated Charges. G. Beck. *Zeits. f. Physik,* 76. 7–8. *pp.* 476–487, *April* 20, 1932.—It is shown that, applying the Abraham–Heaviside theory of the damping of radiation in the frame of the special theory of relativity, results can be obtained with regard to the accelerated motion of a point charge. The energy and impulse of such a charge are found to depend upon the accelerated state. The consequences of this fact are discussed for certain problems, including the motion of an electron, a proton and with less certainty a photon in a powerful field. Some remarks are made on the possible bearing of the theory on the atomic model. H. N. A.

3406. Ionisation of Argon and Neon by Neutral Argon Beams. O. Beeck. *Nat. Acad. Sci., Proc.* 18. *pp.* 311–313, *April,* 1932.—Preliminary experimental work is briefly described with neutral argon beams, produced by causing argon ions to encounter atoms of argon and to neutralise themselves by transferring their charge. Such beams are made to impinge upon (1) argon, (2) neon. Intense ionisation is produced in each case. In A the number of negative ions only slightly exceeds that of the positive ions, in Ne the negative ions are far in excess. By comparing the results with those obtained when K^+ ions are sent through A valuable deductions are made. In addition to explaining the ionisation of the inert gases by slow alkali metal ions, the present work promises to elucidate certain questions in connection with thermo-ionisation, chemical reactions and discharges in gases. [See following Abstract.] N. D.

3407. Ionisation in Gases by Ions and Atoms. F. Zwicky. *Nat. Acad. Sci., Proc.* 18. *pp.* 314–318, *April,* 1932.—When inert gases are ionised by ions of alkali metals of constant energy, four important results are obtained, *viz.,* (*a*) the efficiency of ionisation is a maximum for the ion whose mass is nearest that of the atom; (*b*) the efficiency of ionisation falls away more quickly for ions of smaller mass; (*c*) it increases both with the mass of the ion and that of the atom; (*d*) the speed of the ion necessary to produce ionisation is lowest when the ion and atom are of equal mass. A theoretical explanation of these facts is given. It is shown that the impinging ions cause adiabatic disturbances in the gas atoms in the form of elastic waves. The duration of the impact is calculated and the conditions necessary for ionisation to occur are determined. The theory receives support from the work of Beeck [see preceding Abstract]. Several weak points in the explanation are discussed. N. D.

3408. Production of High-Speed Light Ions without the Use of High Voltages. E. O. Lawrence and M. S. Livingston. *Phys. Rev.* 40. *pp.* 19–35, *April* 1, 1932.—Beams of protons of kinetic energies exceeding those of electrons of 10^6 volt-velocity are obtained as follows: Electrodes in the form of semicircular hollow brass plates are mounted with their diametral edges adjacent, in a vacuum and in a uniform magnetic field perpendicular to the plane of the plates. An oscillating electric field is produced by h.f. oscillations applied to the electrodes in the diametral region where ions are accelerated. They then describe semicircles inside the electrodes, the time taken being arranged to be a half-period of the oscillations. When they re-emerge into the diametral region they are again accelerated and then describe second semicircles. Repetition of this process gives the ions very high velocities. The focussing action of the electric and magnetic fields gives narrow, intense beams. Using a magnet with pole faces of 11 in. dia., a current of 10^{-9} ampere consisting of protons of $1{\cdot}22 \times 10^6$ volt-velocity has been obtained from a maximum applied voltage of 4000. N. D.

3409. New Method for the Measurement of Ionic Mobility. G. Stetter. *Phys. Zeits.* 33. *pp.* 294–296, *April* 1, 1932.—The apparatus employed comprises a plate chamber with grid and guard-ring into which α-rays, parallel to the plate, and therefore perpendicular to the field, can pass. The plate is connected to a valve electrometer [see Abstract 3085 (1929)]. The beginning of the record is due to the α-ray itself and is shown by a small sharp jump. When the ions generated by the α-ray reach the central collector a second larger jump occurs. The time between the two jumps can be measured from the recording strip and gives the time required by the ions to travel a certain distance determined by the dimensions of the apparatus. From this the mobility of the ions can be found. Possible sources of error are discussed. A. W.

3410. Present Position of Ionic Mobility Theory. L. B. Loeb. *Zeits. f. Physik*, 75. 7–8. *pp.* 555–561, *April* 20, 1932.—Criticisms of an old ionic theory of the author's by Druyvesteyn [see Abstract 1353 (1932)] are considered and shown to be unnecessary in the light of more recent work, by which the older theory should be replaced. A brief discussion is also given of the present position of the ionic mobility theory. A. W.

3411. Dissociation by Bombardment with Positive Ions. A. Schechter. *Zeits. f. Physik*, 75. 9–10. *pp.* 671–675, *April* 29, 1932.—Previous experiments on the dissociation of hydrogen and nitrogen by collisions with positive ions are repeated with an improved technique. In contradiction of results obtained by Mitchell [see Abstract 614 (1931)], the new investigations confirm the author's previous discoveries, namely, the strict dependence of the pressure decrease, interpreted as dissociation, on the ionic energies and on the presence of critical potentials. The dissociating power of a single ion is discussed with reference to Mitchell's work. J. E. K.

3412. Electric Diffusion of Ions in Unipolar Charged Gases. N. Wolodkewitsch. *Zeits. f. Physik*, 75. 9–10. *pp.* 680–686, *April* 29, 1932.—It is shown that when a cloud of spherical ions with homogeneous density of charge and the same mobility diffuses into a gas, the process is such that the density of charge remains homogeneous. By streaming a unipolar charged gas with ions of a single mobility through a tube it was found that an initial homogeneous density of charge remained homogeneous and exhibited a change with time governed by the same laws as had been found for clouds of spherical ions. In contrast to diffusion in accordance with the kinetic theory of gases, the relative losses in tube conduction with electric diffusion increase with increasing density of charge and are independent of the tube radius. For the case of streaming of ions of different mobilities the term "effective mobility" is introduced, and formulæ for calculating this quantity and a diffusion method for measuring it are given. A. W.

3413. Theory of Recombination of Ions in Gases at High Pressures. W. R. Harper. *Cambridge Phil. Soc., Proc.* 28. *pp.* 219–233, *April*, 1932.—An approximate quantitative theory of the recombination of gaseous ions is given in which both the Brownian motion of the ions and their motion due to the electrostatic field are taken into account. The frequency of those encounters which lead to recombination is calculated for a gas at high pressure. The results agree well with those derived from experiment. The effect of an external field on the coefficient of recombination is considered and shown to be small. The question of preferential recombination between an ejected electron and its parent positive ion, which seems to play an important part at high pressures, is discussed. N. D.

3414. Theory and Method of Determination of Size of Ions in the Atmosphere. H. Israël. *Gerlands Beitr. z. Geophys.* 35. 3–4. *pp.* 341–348, *and* 36. 1. *pp.* 24–37, 1932.—In determining the size and mobilities of ions by condenser methods [see Abstract 4294 (1931)] errors are introduced because the field at the end of the condenser is never homogeneous. This edge-field is considered in terms of a hypothetical condenser placed before the real one, and, since the charging and discharging methods affect the field differently, they are considered separately. Two constants of disturbance, *a* and *i*, reciprocals of which give a direct value of the disturbance, are defined. The measured number of ions and mobility are corrected by them, and it is shown that discharging gives the better value for the number of ions, and charging for the mobility. Corrections for the end-effect are worked out for the four possible arrangements of the electrical connections. H. M. B.

3415. Growth of Space Charges in Electric Breakdown of a Gas. N. Kapzov. *Zeits. f. Physik,* 75. 5–6. *pp.* 380–390, *April* 6, 1932.—The method given previously by Hippel and Franck for calculating the development of positive space charges in a spark gap shortly before breakdown occurs is here further developed. As a result it is found that Hippel and Franck's theory may be able to explain the short breakdown times observed by Rogowski. A. W.

3416. Space-Charge Currents of Oxide Kathodes. A. Gehrts. *Zeits. f. techn. Physik,* 13. 4. *pp.* 192–195, 1932.—Experiments were made with high-vacuum tubes with oxide kathodes. A comparison of the calculated space-charge characteristic lines with the observed space-charge lines got from the tube REN–904 (radio valve) gave the following results: (1) The sectional resistance of the oxide layer gives rise with oxide kathodes to a flattening of the characteristic lines. (2) The sectional resistance varying exponentially with the reciprocal values of the temperature of the kathode conditions a marked dependence of the steepness of the characteristic lines on the heating of the kathode. (3) From the space-charge current measurements values are got for the sectional resistance which agree well with the measured values obtained by Lübcke and Kroczek. J. J. S.

3417. Theory of Secondary Emission from Metals. H. Fröhlich. *Ann. d. Physik,* 13. 2. *pp.* 229–248, *April* 18, 1932.—Calculations are made of the energy of the secondary electrons liberated from the face of a sheet of metal on which kathode- or canal-rays are incident. The results in general are in agreement with experiment. There is a lower limit, of the order of 10 volts, for the primary energy necessary for the production of secondary electrons; this lower limit is determined mainly by Pauli's principle. To a first approximation the secondary electrons have velocities below 25 volts independent of the primary energy. In the case of thin sheets of metal the emission of secondary electrons from the exit face is much greater than from the incidence face. For 100 volts primary energy there is about one secondary electron for each primary electron. A. W.

3418. Neon-Lamp Method for the Measurement and Registration of Photoelectric Effects. A. Stäger. *Helv. Phys. Acta,* 5. 1. *pp.* 26–30, *Feb.,* 1932. *In German.*—It is shown experimentally that the well-known arrangement for the production of relaxation oscillations, consisting of a neon glow lamp, with a capacity in parallel and a resistance in series, may with a suitable operating potential be employed to measure the intensity of photoelectrically active and ionising radiation. The frequency of the relaxation oscillations can be influenced to a considerable degree by the action of daylight, ultra-violet rays, X-rays and γ-rays. [See following Abstract.] A. W.

3419. Neon-Lamp Method for the Measurement and Registration of Photoelectric and Other Effects. A. Stäger. *Gerlands Beitr. z. Geophys.* 36. 1. *pp.* 145–149, 1932.—It is suggested in the present paper to use this device [see preceding Abstract] for the measurement of geophysical radiation, especially of ultra-violet light and of γ-rays. The frequency is increased by irradiation of the neon lamp with ultra-violet light, but is diminished by radiation if an ionisation chamber sensitive to the radiation is connected in parallel with the lamp. An apparatus suitable for geophysical measurements can be constructed which is easy to operate, insensitive to mechanical shocks, temperature changes and humidity. The method can also be applied for simultaneous and automatic registration. A. W.

3420. Photoelectric Cell with Large Kathodes. R. Fleischer. *Zeits. f. techn. Physik,* 13. 2. *pp.* 92–94, 1932.—Describes the construction of photoelectric cells having large kathodes and not requiring an accelerating potential. The kathode is the inner silvered surface of a Dewar vessel and a central cylinder. In the space between them is a wide-meshed wire gauze forming the anode, held in position by special holders which act at the same time as conductors. To avoid contact potentials, both anode and kathode are made of the same material. Anode and kathode are everywhere 15 mm. apart, and the whole surface of the kathode is 1200 sq. cm. The surface of the anode is kept small to avoid the light acting upon it. The author states that the cell acts without an accelerating potential strongly enough to actuate a small counter.

E. E. F. d'A.

3421. Photoelectric Cell Circuit. G. A. Woonton and R. G. Elson. *Canad. J. of Research,* 6. *pp.* 444–451, *April,* 1932.—It is shown that a valve circuit of special design is capable of linear response to the varying conductivity of a photoelectric cell. A method is suggested whereby light intensities of widely different magnitudes can be compared. The circuit is shown to be extremely stable. AUTHORS.

3422. Constitution of the Oxide in Cuprous-Oxide Rectifiers and Photoelectric Cells. L. Dubar. *Comptes Rendus,* 194. *pp.* 1332–1334, *April* 18, 1932.—Previous work is continued [see Abstract 2391 (1931)]. The author calls that form of cuprous oxide which has a relatively low resistance the conducting oxide, and that form which by prolonged heating in a closed vessel in presence of metallic copper has acquired a much higher resistance the semi-insulating oxide. The first kind forms the outer layer and the second the stopping layer of a rectifier. A number of chemical and physical tests are made to reveal the cause of the different properties of these oxides, *e.g.*, chemical analysis, microscopic examination, Debye-Scherrer X-ray analysis, electric resistance of single crystals, etc. It appears that Cu_2O would be a perfect insulator, but, in practice, the presence of a minute quantity of some unknown substance renders it conducting. This substance is probably present in the state of a solid solution. N. D.

3423. Photoelectric Absorption in Hydrogen-like Atoms. P. A. M. Dirac and J. W. Harding. *Cambridge Phil. Soc., Proc.* 28. *pp.* 209–218, *April,* 1932.—The authors consider the reaction between an electron in the central field of a nucleus and an incident electromagnetic wave which is assumed to produce a small perturbation. The latter induces transitions from the ground state to one of the continuous set of free states, and the absorption coefficient is given by a matrix expression. The difficulty is to evaluate the matrix elements which lead to integrals which involve the continuous-wave functions and are mathematically intractable. However, the total integrated absorption for all frequencies can be obtained, as well as the three successive moments of the total absorption curve. Moments higher than the third are infinite, and this enables the conclusion to be drawn that for large frequency the absorption coefficient varies inversely as the nth power of the frequency, where $4 < n \leqslant 5$. W. S. S.

3424. Light Absorption and Selective Photoelectric Effect. H. Fröhlich. *Zeits. f. Physik,* 75. 7–8. *pp.* 539–543, *April* 20, 1932.—From theory it is not expected that very thin films of alkali metals will show a particular maximum due to the number of light quanta absorbed. The emission will generally increase with the frequency of the light absorbed up to the quantum equivalent of photo-emission. Neglecting molecular roughness of the surface, such films should only absorb light with the electric vector perpendicular to the metal surface. F. S.

3425. Valve Oscillators Operating Near the Limit of Maintenance of Oscillations. Y. Rocard. *Comptes Rendus,* 194. *pp.* 1325–1327, *April* 18, 1932.—Expressions are derived for (*a*) the amplitude of various harmonics, (*b*) the oscillation period, and (*c*) a time-constant applicable to the initial period of a valve oscillator operating near the limit of maintenance of oscillations. The expressions are derived from a solution by successive approximations of a second order equation analogous to that used by van der Pol in discussing relaxation oscillations. In a subsequent paper it will be shown that similar expressions may be derived for the case of oscillations determined by equations of order higher than the second. A. W.

3426. Kathode-Ray Frequency Multiplier. N. C. Jamison. *Physics,* 2. *pp.* 217–224, *April,* 1932.—A vacuum tube was constructed having a filament and slit arrangement for the production of a sheet of electrons, one pair of deflecting plates, and a receiving plate composed of a series of rectangular conductors. Adjacent conductors were insulated from one another and alternate conductors were in electrical connection. An alternating p.d. applied to the deflecting plates causes the electron beam to move across the surface of the receiving plate current flowing first to one set of conductors and then to the other set. During one complete cycle of the deflecting plate field, the currents from the two sets of conductors will pulsate with frequencies which are multiples of the frequency applied to the deflecting plates. By applying steady potentials to the deflecting plates, the current to each set of conductors may be measured and plotted as a function of the deflecting plate p.d. Such static characteristic curves were examined for widely different currents, potentials, and gas content of the tube. Tests with an alternating p.d. applied to the deflecting plates gave very definite indications of receiving-plate currents of two, four and six times the frequency of the applied field. AUTHOR.

3427. Potential Dividers for Kathode-Ray Oscillographs. F. P. Burch. *Phil. Mag.* 13. *pp.* 760–774, *April,* 1932.—In Gábor's oscillographic method for observing transients, the transient is first made to operate a relay near the oscillograph and then conveyed to the voltage-deflection plates by wires long enough to delay its arrival until after the relay has operated and released the beam from a blocking chamber and started the time-sweep. The method is limited by the energy required by the delay wires. When the voltage under investigation is high the delay wires may be connected to tappings on a potential divider and then under certain conditions the disturbance of the source is negligible. It has been found, however, that if the low-voltage impedance of the system is divided between the two ends of the delay line, the condensers may be made from six to eight times smaller than when it is concentrated at one end only. The field of application of the method is thus greatly extended. A. W.

3428. Characteristic Oscillations of Ionised Gases according to Wave Mechanics. J. J. Placinteanu. *J. de Physique et le Radium*, 3. *pp.* 155–159, *April*, 1932.—J. J. Thomson's formula $\nu = (e^2N/\pi m)^{\frac{1}{2}}$ for the frequency of an ionised gas is always obtained by classical calculations. This is due to the fact that the resonance frequency of two series of virtual oscillators is always calculated, one due to the field, the other due to the model taken to represent the system ion-electron. Wave-mechanical methods give several frequencies (instead of one), which correspond to the different states of energy in which the model may happen to be. The values differ very little from a limiting frequency and are given by the formula $\nu = (2e^2N/\pi^2 m)^{\frac{1}{2}}(1 - a_0/a \,.\, f(l,n)$, where $a_0/a \sim 1$ and $f(l,n)$ has values corresponding to the different states n, l. H. L. B.

3429. Source of Error in the Capillary-Wave Method of Frequency Measurement. M. Katalinić. *Zeits. f. techn. Physik*, 13. 5. *pp.* 239–241, 1932.—Wire-electrode oscillations must be avoided when using the Schultze capillary waves for frequency measurements or for obtaining the capillary constant; and this is attained by suitable shortening of the wire length. When distilled water is employed as the dielectric liquid, there occur in the wire-electrode oscillations two sharply separated resonance frequencies which are due to the intermittent character of the dielectric displacement force and the charge phenomena. Examples of distortion are included. H. H. Ho.

3430. New Algebraic Representation of A.C. and All Other Oscillatory Phenomena. A. Blondel. *Comptes Rendus*, 194. *pp.* 1413–1417, *April* 25, 1932.—A mathematical method is given of dealing with a.c. by using the quadrant of a circle as unit instead of the radian. The quickness of obtaining the instantaneous power of sinusoidal a.c. and currents which may be expressed as a Fourier series is shown. The method can be extended to all electrical and mechanical oscillations.
H. M. B.

3431. Characteristic Electrical Vibrations of Rod-Shaped Conductors. K. F. Lindman. *Ann. d. Physik*, 13. 3. *pp.* 358–372, *April* 20, 1932.—Between the wave-length λ_1 of the electrical fundamental vibration of a rod-shaped conductor and the geometrical length l of the same there exists the relation $\lambda_1 = 2l(1 + \epsilon_1)$, where ϵ_1 is a small positive number dependent on the relation of the length l to the radius of cross-section of the conductor. For this number ϵ_1 various expressions have been theoretically deduced: according to Abraham, $\epsilon_1 = 1 \cdot 4/\Omega^2$, where

$\Omega = 2 \log_e l/p$; according to Oseen, $\epsilon_1 = 0\cdot4514/(\Omega + 2 \log_e 2)$; and according to Hallén, $\epsilon_1 = 0\cdot4514/\Omega + 3\cdot31/\Omega^2$. The author has repeated some earlier experiments and finds that with a copper wire 0·7 to 1·3 mm. thick and 24–73 cm. long the observed values of λ_1 agree within limits of error with Abraham's theory. In the case of conductors with flat ends the results were in good agreement with the values obtained from Oseen's theory. The damping decrement found experimentally ($\delta = 0\cdot41$) of the fundamental vibration of a copper wire 24·2 cm. long and 1·3 mm. thick agreed with the value from Abraham's theory, whilst the theory of Oseen and Hallén gave deviating values. The numbers found for the wave-lengths of the harmonic vibrations in an experiment agreed with Abraham's formula, whilst the values calculated according to Hallén were somewhat greater. J. J. S.

3432. Remanent Magnetism and the New Magnetisation Curve. H. Kühlewein. *Phys. Zeits.* 33. *pp.* 348–351, *April* 15, 1932.—It has been observed, from consideration of ballistic determinations of hysteresis curves for ferromagnetic alloys, that the initial magnetisation curve from zero can be derived in the following way. Magnetisation curves (B–H) are drawn from the two points of remanent induction for fields increasing from zero up to the value required for saturation. The arithmetical mean of the two curves coincides with the new curve or B–H curve obtained starting with zero magnetisation. This result is illustrated by graphs and figures for permalloy and perminvar, and the effect of non-saturation on the result is also shown. G. E. A.

3433. Magnetisation of Ferromagnetic Powders in Weak Fields. R. Chevallier. *Comptes Rendus,* 194. *pp.* 1327–1329, *April* 18, *and pp.* 1468–1471, *April* 25, 1932.—The intensity of magnetisation of an ellipsoidal portion of a substance composed of ellipsoidal grains of a ferromagnetic material embedded in a non-magnetic medium is calculated when the large ellipsoid is placed in a magnetic field H parallel to one of its axes. The susceptibility k of the grain material is known and is constant. If k is great, the intensity is found to be independent of it. The special case of spherical grains in a sphere is discussed. As k decreases, the intensity for constant H also decreases. The effect of non-homogeneous grains is considered separately. In the second paper experimental tests are made using spheres of steel embedded in paraffin contained in spherical glass globes. Cylindrical grains of iron and nickel are also used instead of ellipsoidal grains because of the difficulty of preparation. The results largely confirm the theory. N. D.

3434. Variability of the Magnetic Moments of Ions in Elements of the Iron Series. H. Fahlenbrach. *Ann. d. Physik,* 13. 3. *pp.* 265–296, *April* 20, 1932.—The paper deals with an experimental examination of the characteristics of the magnetic moments of the ions Co^{++}, Ni^{++} and Fe^{+++} in solution. The work is based upon the preliminary investigations of Blumenthal and Vogt on the relationship between the susceptibility and the solvent for Co^{++}, as also the connection between colour and paramagnetism. The present work extends these investigations to other temperatures and other solutions. The susceptibility of aqueous solutions of $NiCl_2$, $CoCl_2$ and $FeCl_3$ is examined, as also the solutions of $CoCl_2$ in pyridin, ethyl alcohol, acetone, etc., and not only is the relationship of susceptibility to temperature and concentration studied, but also the temperature range of the susceptibility of the solvents themselves determined. For water the temperature range of the susceptibility results is in agreement with that of others; for acetone and ethyl alcohol the relationship is linear, and for pyridin there does not seem to be any definite relationship. The coefficients for susceptibility and temperature are: for acetone, $\alpha = -3\cdot3 \times 10^{-4}$; for alcohol, $\alpha = -2\cdot2 \times 10^{-4}$. In normal cases the temperature range of specific susceptibility is given by the Weiss law, and the former calculations of moments from measurements of the susceptibility, at a definite temperature from the Curie hypothesis, are incorrect. No simple relationship exists between colour and paramagnetism in the solutions examined. The dependence of magnetic moment upon concentration is also discussed and appears to be related to the corresponding decreasing exchange effects for neighbouring anions for progressively decreasing concentrations, whereby the l-moment is extinguished according to the Stoner sense. The blue configuration of the Co^{++} ions corresponds to the Stoner exchange effect for coordinated combined complexes. The variation of the magnetic moment with the concentration is dependent upon the saturation value of the solution for the particular solvent and solute. For high values of the saturation value the relationship is weak, for low values the relationship is stronger. S. G. B.

3435. Magnetic Properties of Matter in Strong Magnetic Fields. Parts III, IV and V. Magnetostriction. P. Kapitza. *Roy. Soc., Proc.* 135. *pp.* 537–600, *April* 1, 1932.—Part III.—A discussion of classical magnetostriction, due to lines of magnetic force, atomic magnetostriction, due to the disturbing influence of the magnetic field on the magnetic properties of the substance, and thermal magnetostriction, only apparent in adiabatic magnetisation due to change of temperature. The thermodynamic relationship between magnetostriction and change of magnetisation with stress and strain is considered, moduli or constants of different orders for the adiabatic and isothermal magnetostriction are defined, and symmetry relations for the moduli of quadratic magnetostriction are given. The relation between the elementary moduli for paramagnetic substances is elucidated. Part IV.—The balance used for the determination of susceptibility and previously described is adapted for use as an extensometer. Changes in length down to 10^{-7} cm. can be measured comparatively quickly. The extensometer, duly calibrated according to the details given, is used for the measurement of magnetostriction in strong magnetic fields, and the accuracy of the results and experimental precautions and procedure are outlined in detail. Part V.—A detailed account of the measurement of magnetostriction in crystals of bismuth is recorded. The results indicate that in weak fields at all temperatures the magnetostriction is quadratic, having a positive sign along the trigonal axis and a negative sign perpendicularly. A marked deviation from the quadratic occurs in strong fields at low temperatures, and the magnetostriction appears to have a saturation effect. An atomic magnetostriction is also found in Sb, graphite, gallium and probably in tungsten and Sn, whilst the limits of a possible magnetostriction are established for beryllium, Mg and rock-salt. Tentative explanations are suggested as explanations of the phenomena, and a discussion of the results is appended in the light of the modern theory of diamagnetism. [For Parts I and II see Abstract 2804 (1931).] S. G. B.

3436. Diamagnetism and Structure of Compounds of Ethylene, Carbon Tetrachloride and Titanium Tetrachloride. V. I. Vaidhianathan and B. Singh. *Indian Journ. Phys.* 7. *pp.* 19–26, *April* 1, 1932.—The magnetic susceptibilities of C_2H_4, $C_2H_4(OH)_2$, $C_2H_4(NH_2)_2$, $C_2H_4Cl_2$, $C_2H_4Br_2$, $C_2H_4I_2$, CCl_4 and $TiCl_4$ have been determined, special care being taken to purify the substances by repeated distillations at their boiling points and recrystallisations in the case of $C_2H_4I_2$. A high sensitivity Curie balance with quartz suspension and retorsion head was employed. Deviations from additivity relations were found in most cases. An attempt is made to interpret these deviations from the standpoint of the nature of the valency links. AUTHORS.

3437. Diamagnetism of Bismuth. S. R. Rao. *Indian Journ. Phys.* 7. *pp.* 35–42, *April* 1, 1932.—Colloidal bismuth when melted and recrystallised shows an increase in its diamagnetic susceptibility value (χ). This result confirms the observation that χ decreases with particle size. Attention is drawn to the work of Goetz (*Phys. Rev.* 38. *p.* 2075, *Dec.*, 1931), who finds that there is a superposition of a macroscopic structure on the lattice structure in bismuth crystals. The possibility of a connection between this mosaic structure and the variation of the diamagnetic susceptibility with particle size is indicated. AUTHOR.

3438. Thermal Law of Homopolar Linkages at the Curie Point and Melting Point. R. Forrer. *Comptes Rendus*, 194. *pp.* 868–869, *March* 7, 1932.—The author has recently shown [see Abstract 3002 (1932)] that at the Curie point the thermal law $\theta = T_1\sqrt{N}$ becomes discontinuous, where N is the number of contacts effected between the orbits of one atom with those of its neighbours, and T_1 is the absolute temperature for $N = 1$. The author designates these contacts between orbits of neighbouring atoms as constituting a homopolar linkage. This being assumed, he then admits that the law of the Curie points is applicable without change to the point of fusion, to the point of transformation, and to the anomalous temperatures. The several cases are discussed in detail. In conclusion he states that the ordinary temperature becomes, according to his reasoning, the temperature *par excellence*, where a large number of chemical reactions become possible, and finally he designates the law $T = T_1\sqrt{N}$ as the law of solid bodies. S. G. B.

3439. Weiss Molecular Field. K. Honda. *Zeits. f. Physik*, 75. 5–6. *pp.* 352–362, *April* 6, 1932.—Shows that the idea of a molecular field, which Weiss has used to explain ferromagnetism, employing the analogy of Langevin's theory of paramagnetic gases, is subject to a series of difficulties to which attention has already been called by different authors. The object of the author's investigation is to show that the assumption of a molecular field of this kind is incorrect. In the theory which has been advanced by Okubo and the author there is a spontaneous magnetisation of the same kind as that of Weiss, the only difference being that, instead of the extremely strong molecular field postulated by Weiss, they only take into account the magnetic reciprocal action between neighbouring poles. The author shows that there is very satisfactory numerical agreement between his theory and the experimental facts, particularly with regard to the magneto-caloric effect, and that the Weiss theory fails to explain a number of important facts. H. N. A.

3440. Problem of the Rotating Magnet. J. Zeleny and L. Page. *Phys. Rev.* 40. *pp.* 299–306, *April* 15, 1932.—The analysis of the problem of the rotating magnet previously given by us [see Abstract 633 (1925)] is extended. For the special cases considered, it is shown that, while the magnet exerts equal and opposite torques on the portions of the current circuit inside and outside of the magnet, neither of these portions individually exerts any torque on the magnet itself. The analysis is applied also to the case where the magnet is replaced by a solenoid, and to the case where the magnet is replaced by a brass cylinder and the flux through it is supplied by an outside coaxial solenoid. Pietenpol and Westerfield's recent criticism of our previous analysis [see Abstract 1749 (1932)] is shown to be mistaken, and the fault in their method of attacking the problem is found to lie in the application of Ampère's original law to the interaction between two current elements where in general it is invalid. AUTHORS.

3441. Electromagnetic Equations and Systems of Units. L. Page. *Physics,* 2. *pp.* 289–302, *April,* 1932.—The electromagnetic equations are put in their most general form and the following criteria for a useful set of equations and sets of units are established: (1) there should be only one set of fundamental equations, (2) there should be two sets of units, one c.g.s. for the physicist and one practical for the engineer, (3) the eight internationally recognised units should be retained in the practical system, (4) the fundamental equations should be symmetrical in form. It is shown that these criteria can be fulfilled in an infinite variety of ways, of which the Heaviside-Lorentz system of equations provides the simplest. The relations between c.g.s. and practical units employing this system of equations are tabulated. AUTHOR.

3442. Probable Values of e, h, e/m and α. R. T. Birge. *Phys. Rev.* 40. *pp.* 228–261 and 319–320, *April* 15, 1932.—In the author's previous derivation of the most probable values of e and h, a most probable value of e was first obtained and then inserted into equations from which h could be derived. In reality, however, all experimental methods give numerical coefficients in equations involving *both* e and h. The present paper gives a logically correct method of evaluating simultaneously the values of e and h from the several known functional relations between these two constants. The latter all take the form $h = \mathrm{A}_n e^n$ where $n = 3/3$, $4/3$ or $5/3$, and A_n is an experimentally determined magnitude. Introducing a new parameter $h_n = \mathrm{A}_n e_0^n$ where e_0 is an arbitrarily selected approximate value of e, the linear equation $h_n = h - (h_0 \Delta e/e_0)\, n$ is obtained and for each of the above n-values experiment gives h_n. Fitting the best straight line to the graph of h_n against n, by least squares, the intercept at $n = 0$ gives h, and the slope gives $e(= \Delta e + e_0)$. This method is extended by rewriting the functional relations in the form $e = a_m h^m$, which enables $m = 0$ to be included, this corresponding to the determination of e by a method not involving h. Adopting this method of analysis, the author makes an exhaustive study of the various sets of experimental data which can be used to derive values of e, h and allied constants. His general conclusions are: (1) All recent work leads to a value for $1/\alpha = hc/2\pi e^2$ equal to $137 \cdot 307 \pm 0 \cdot 048$, whereas Eddington's theory gives the value 137. (2) It seems that the crystal wave-lengths of X-rays are correct, and the close agreement of the resulting value of e with the oil-drop value points to the absence of important unsuspected error in Millikan's work. (3) The most probable values of the constants ($h = 6 \cdot 5443 \pm 0 \cdot 0091$,

$e = 4\cdot7688 \pm 0\cdot0040$, $1/\alpha = 137\cdot307 \pm 0\cdot048$, and $e/m = 1\cdot7611 \pm 0\cdot0009$) are derived, but as the values differ so little from those published in 1929 no change is advocated at this time, although the probable errors then given are more or less in error. In an *Addendum* two minor corrections are made, account is taken of some new data, and the bearing of the values of the constants, on Eddington's new theory concerning the ratio of the mass of the proton to that of the electron, is discussed. [See also Abstract 3110 (1932).] W. S. S.

3443. Determination of Electrical Units. H. L. Curtis. *Washington Acad. Sci., J.* 22. *pp.* 193–211, *April* 19, 1932.—An historical account of methods of determining electrical units by mechanical methods. J. E. R. C.

APPARATUS AND INSTRUMENTS.

3444. Electroscope Capacity Balance. E. S. Brown. *Phys. Soc., Proc.* 44. *pp.* 220–223, *March* 1, 1932.—Capacities of a few $\mu\mu$F are measured by means of two electroscopes connected in series with a source of e.m.f. and shunted by variable condensers. The intersection of the gold leaves lies on a straight line so long as the capacities of the condensers are equal. The unknown capacity is shunted upon one of the condensers, the capacity of which is then adjusted till the sum of the two capacities is equal to the capacity of the remaining condenser. **Erratum,** *ibid.*, May 1, 1932. AUTHOR.

3445. Capacity of a Two-Plate Electrometer. G. Nadjakoff. *Phys. Zeits.* 33. *pp.* 345–348, *April* 15, 1932.—The author describes a method of determining the capacity constant and true capacity of a two-plate quadrant electrometer. Experimental results are given which illustrate the large differences which may exist between the true capacity and the effective capacity of the suspended system. [See Abstracts 2591 and 2592 (1932) and the two following Abstracts.] J. E. R. C.

3446. Sensitivity of a Two-Plate Electrometer. G. Nadjakoff. *Zeits. f. Instrumentenk.* 52. *pp.* 132–138, *March,* 1932.—The charge and potential sensitivity of the Dolezalek two-plate electrometer are calculated. Measurements of these quantities are made with two different sizes of suspension wire, and the constants of the electrometer are thus determined. Curves are plotted showing the variation of charge sensitivity with capacity and auxiliary potentials. The charge sensitivity passes through a maximum, the position of which depends upon the total capacity of the system. [See preceding and following Abstract.] J. E. R. C.

3447. Electrical Forces in a Quadrant Electrometer. G. Nadjakoff and V. Postompirova. *Zeits. f. Instrumentenk.* 52. *pp.* 187–192, *April,* 1932.—The deflecting force may be written as $D = R + rV^2$, where R = the force due to the suspension, V is the deflecting field, and r is a coefficient, the value of which depends upon the conditions. Measurements are described in which the effects of a tilt are investigated. The needle is tilted both about its long and its short axes and for each case the needle is restored to its central position by means of a traversing device. The amount of traverse needed to do this gives a measure of the magnitude of the tilt. Values of r are given in each case, and curves are plotted showing the variation of sensitivity with each position. [See the two preceding Abstracts.] J. E. R. C.

3448. Effective Capacity of the Quadrant Electrometer. J. J. McHenry. *Phil. Mag.* **13.** *pp.* **650–664,** *March,* **1932.**—An expression for the effective capacity of a quadrant electrometer is derived, in which it is expressed in terms of the potential of the needle and the torsional modulus of the suspending fibre. The relation between effective capacity and a certain function of the needle potential is found to be linear. The former is measured experimentally by a method involving comparison with a standard condenser, and the linear relation is found to hold. The effective capacity increases when the needle potential is increased, but the relation is not linear. The sensitivity of the instrument in measuring both charges and potentials is dependent on the needle potential. That value of the needle potential which causes greatest sensitivity in measuring charges is raised if an external condenser is added to increase the electrometer capacity, and approaches that needle potential which causes greatest sensitivity in measuring potentials. A certain group of four constants determines the behaviour of the instrument. N. D.

3449. Transverse Pressure Electrometer. H. Hermann. *Ann. d. Physik,* **12. 8.** *pp.* **990–992,** *March* **10, 1932.**—A spherical condenser is divided into two equal parts by a plane (horizontal). The two halves can be shifted a little relatively to one another, perpendicular to the dividing plane. The field is prevented from spreading at the break by low cylindrical guards. The attraction between the two halves is not due to any pull along the lines of force, but wholly to the Maxwell pressure at right angles to the lines. H. N. A.

3450. New Portable Electrometer. R. Gunn. *Phys. Rev.* **40.** *pp.* **307–312,** *April* **15, 1932.**—The fundamental principles underlying the operation of a new type of portable electrometer are given. It is shown that the periodic transfer of static charges from one capacity system to another and back again can be used to produce an alternating electrical potential. The alternating potential is amplified by means of vacuum tubes, then rectified by a synchronous commutator and the resulting direct current used to operate an indicator. Instruments with capacities of about 25 cm. and sensitivities of 10^4 μA per volt have been built to operate with portable microammeters used as the indicator. The period of the device depends on the indicator employed and is small. AUTHOR.

3451. Measurement of Electrical Resistance in Terms of a Mutual Inductance and a Period. H. R. Nettleton and F. H. Llewellyn. *Phys. Soc., Proc.* **44.** *pp.* **195–216;** *Disc.,* **216–219,** *March* **1, 1932.**—It is shown that if the ratio a/a of the radii of the concentric circles forming a simple inductometer is $0 \cdot 50607_8$, the mutual inductance is so accurately proportional to the angle through which the turning coil is displaced that the rising deviation from a linear law is less that five parts in a million at 7° of deflection. If the outer circle is replaced by two twin circles which are separated symmetrically with regard to the turning coil, the ratio a/a must be increased to bring about a similar approach to linearity. If a heavy dynamometer is constructed on this principle, then, over the range indicated, the deflecting couple is strictly proportional to the current-products. Moreover, if such a dynamometer be damped electrically, the damping-couple is accurately proportional to the velocity and, over a range of oscillation of 14°, there is a remarkably close approach to true damped simple harmonic motion. It is shown that the resistance of the oscillator circuit is very accurately given by the expression

$$R = \frac{CM}{c} \Big/ \left[\frac{\lambda T}{\pi^2 + \lambda^2} - \frac{\lambda_0 T_0}{\pi^2 + \lambda_0^2}\right],$$

where λ is the logarithmic decrement and T the period on closed circuit of the oscillator when a current C traverses the field coils, while λ_0 and T_0 correspond to open circuit and M is the mutual inductance between the oscillating coil and the field coils when the former is in the position of steady deflection due to the passage through it of a steady current *c*, in conjunction with the current C through the field coils. This expression eliminates quantities difficult to measure in Weber's method. Experimental tests are described. Tables of Legendre and other functions, which facilitate the calculation of mutual inductances of the nature here considered, are appended. AUTHORS.

3452. Rectifier Circuits for Small A.C. Measurements. J. A. Darbyshire. *Journ. Sci. Instruments,* 9. *pp.* 123–127, *April,* 1932.—The properties are discussed of circuits designed for the study of the ripple that existed in an h.t. circuit used in connection with some electron diffraction experiments. AUTHOR.

3453. Measurement of Intense Direct Currents. C. Dietsch. *Comptes Rendus,* 194. *pp.* 1466–1468, *April* 25, 1932.—The work of a previous paper is continued [see Abstract 3965 (1931)]. The residual magnetism of the core of the transformer employed introduces difficulties in the method. The effect of this magnetism is eliminated by arranging that the maximum induction of the hysteresis cycles round which the core is taken shall exceed a certain value. This is done by altering the small d.c. whose magnetic field opposes that of the strong current to be measured, until the phase difference of the d.c. primary and secondary currents in the transformer is a minimum. A sensitive wattmeter is used as an indicator of phase difference. The relation $I_1 = n_2 I_2$ still holds. N. D.

3454. Measurement of a Mica Capacitor. H. L. Curtis, C. Matilda Sparks, L. Hartshorn and N. F. Astbury. *Bureau of Standards, J. of Research,* 8. *pp.* 507–523, *April,* 1932.—A mica capacitor was transported on four occasions between the Bureau of Standards and the N.P.L. Seven sets of measurements of capacitance and power factor were made upon it, five at the Bureau of Standards and two at the N.P.L. The principles underlying the methods of the two laboratories are quite different. At the Bureau of Standards the capacitor was compared by a.c. with an air capacitor, the capacitance of which can be determined in terms of resistance and time. At the N.P.L. the mica capacitor was compared by a.c. with a mutual inductance, the value of which can be computed from the dimensions. The two methods were found to give values in good agreement. The measured capacitances agreed to 1 or 2 parts in 10,000, which is within the limits of accuracy of the experiments. J. J. S.

3455. New A.C. Comparator. D. C. Gall. *Journ. Sci. Instruments,* 9. *pp.* 132–134, *April,* 1932.—A description of a modified form of a.c. potentiometer, specially designed to read correctly despite variations of the voltage of the input mains. The instrument is in two parts, an "in-phase" bridge and a "quadrature bridge," which express the resultant e.m.f. in the form $E = e_1 + je_2$, where e_1 and e_2 are the readings on the respective bridges. The potentiometer is supplied from a volt-box, giving a known fraction of the mains voltage; thus variations in the supply voltage affect the potentiometer and the external circuit to an equal extent in most cases. It is essential for this purpose that the potentiometer itself shall have linear constants with respect to current, and for perfect compensation the test circuit should also have linear characteristics. If the test circuit departs from linearity, the compensation is imperfect, but the disturbing factor is much reduced. G. E. B.

3456. Construction of an Air-Cooled Electromagnet. I. Walerstein and A. I. May. *Rev. Sci. Instruments*, 3. *pp*. 136–144, *March*, 1932.—An air-cooled electromagnet for work on the Zeeman effect is described. The instrument is of the Boas type, but includes a number of improvements. The yoke is made of a wider cross-section, thereby preventing the approach of the pole-pieces under strong fields. The cooling is effected by a forced draught of air circulated between the coils by a fan. For a gap of 1 mm. and a current of 33 amperes a field of 48,500 gauss was reached. J. T.

3457. Permanent Magnet for β-Ray Spectroscopy. J. D. Cockcroft, C. D. Ellis and H. Kershaw. *Roy. Soc., Proc.* 135. *pp*. 628–636, *April* 1, 1932.—The construction and use of a large permanent magnet are described. With an air gap of 5·5 cm. and pole faces of 500 sq. cm. a maximum field of 2300 gauss is obtainable. The magnetic field can easily be changed and set to a new value by passing suitable currents through the field coils. AUTHORS.

3458. Regulating Valve for Gas Discharge Apparatus. K. Becker and M. Pirani. *Zeits. f. techn. Physik*, 13. 5. *pp*. 216–218, 1932.—The discharge apparatus is connected by a suitable length of very fine capillary tubing to a bulb of about 50 c.c. capacity containing a supply of the gas. The open end of the capillary within the reservoir bulb is closed by a rubber pad mounted on a bimetallic strip, which can be heated by means of a small heating coil. In use, when the discharge tube runs hard, the heating current is switched on, causing the valve to open and permit any desired small quantity of gas to leak into the discharge tube. G. E. B.

RADIOGRAPHY AND ELECTROPHYSIOLOGY.

3459. Spectral Erythemic Reaction of the Untanned Human Skin to Ultra-Violet Radiation. W. W. Coblentz, R. Stair and J. M. Hogue. *Bureau of Standards, J. of Research*, 8. *pp*. 541–547, *April*, 1932.—The spectral erythemic reaction of three persons exposed to equal amounts of homogeneous ultra-violet radiation, of various wave-lengths, is described. The source of radiation was a standard vertical quartz mercury-vapour lamp which has a series of intense conveniently spaced emission lines, extending from 248 to 365 mμ. These emission lines were separated by passage through the spectrometer exit slit, the jaws of which were dusted with anthracene, which, by fluorescence, indicated the accuracy of the isolation of the line under investigation. The erythemal reaction and the radiometric measurements were made on the spectral line directly behind the exit slit. In the region of 250 mμ the spectral erythemic reaction was supplemented by exposures to the heterogeneous radiation from a mercury-vapour lamp having a high selective emission in the resonance line at 253·7 mμ. Data are given on the reciprocity of intensity and time of exposure, and also on the relative spectral erythemic reaction in the range of wave-lengths extending from 245 to 315 mμ. AUTHORS.

3460. Air Density Corrections for X-Ray Ionisation Chambers. L. S. Taylor and G. Singer. *Bureau of Standards, J. of Research*, 8. *pp*. 385–391, *March*, 1932.—An X-ray unit of dosage, the Röntgen, has been defined on the basis of ionisation of air at N.T.P. In the earlier applications of X-ray treatment, the inherent errors in general did not necessitate the utmost accuracy. Recent developments in therapy however render accuracy of measurement of dosage of importance, and the air varies as respects ionisation with the composition, moisture content, temperature and pressure. Detailed curves and calculations with respect to corrections for these factors are given. It is found that the temperature-pressure corrections are of the greatest importance and, under ordinary conditions of working, may amount to 8 %. In calibrating an ionoquantimeter, the temperature and pressure at which it is intended to be used in practice should be specified, as at extremes of temperature and low pressures at high altitudes, large errors may be present. The use of radium for purposes of calibration and control is recommended. B. J. L.

3461. Advances in X-Ray Engineering with Special Reference to High Potentials. G. Grossmann. *Brit. J. of Radiology*, 5. *pp*. 252–267; *Disc.*, 267–268, *March*, 1932.—In 1920 protective measures for h.t. X-ray tube operation developed in two directions. Siemens developed their well-known protective cupolas surrounding the X-ray tube, the exciting apparatus for which was in another room. Six years later Holfelder developed his well-known " cannon." The second method of development was in the direction of introducing the protective material actually into the construction of the X-ray tube, a method first utilised in 1920 by the General Electric Company of America for small power apparatus. Protective metal tubes of Zehnder (in 1915), of Philips and of Siemens for higher power are described. Practical difficulties arise with oil immersion of the tubes, and more suitable methods were only possible upon the development of suitable armoured h.t. cables. As a result it became possible to shield the tube by an earthed metal container for high voltages and power, a tube known as the " Tuto " tube being developed by the Siemens–Reiniger–Veifa combine, which is illustrated in construction and in use. The h.t. generator, utilising four valves, was likewise enclosed in an earthed metal casing and this has been applied to produce a h.t. apparatus named the " Stabilivolt " apparatus, to be utilised for the purposes of deep therapy. The distribution of potential in X-ray tubes and h.t. thermionic valves is discussed and the practical methods of overcoming brush discharge, etc., are considered, and improvements have resulted in the production of reliable valve tubes which can operate at 450 kV and 5 mA, the length of which is not greater than 2¾ ft. As a result X-ray exciting apparatus to operate at 550 kV has been built, although such apparatus has not yet been operated in practice. An oil-immersed tube, with a protective shield, utilised with such exciting apparatus, is described. B. J. L.

3462. Economy and Quality in Radiology. A. Bouwers. *Brit. J. of Radiology*, 5. *pp*. 311–323, *April*, 1932.—It is pointed out that there are two prime causes of " unsharpness " in a radiograph, (1) due to geo-

metrical causes (finite size of the focal spot) and (2) due to movement. Curves are given showing how (1) depends on the size of the focal spot, and (2) on the time of exposure, and from these the optimum conditions for exposure are deduced. With tubes of standard type it is shown that for greatest economy the tube should be loaded as fully as possible, and the time of exposure (in the case of moving organs—heart, lungs, etc.) adjusted to about 0·1 sec. by varying the focus-film distance. A new form of generator which gives a single-pulse, flat-topped voltage discharge is described. The time-period of the discharge is of the order of 0·1 sec., and hence the characteristics of the generator are good. The generator operates essentially on the principle of discharging a condenser through an inductive circuit adjusted to critical damping. Finally, it is suggested that the voltage applied to the X-ray tube is not of vital importance, and that a moderate voltage of the order of 50 kV is, in general, adequate.
G. E. B.

3463. Chirotherm Valve Oscillator for Surgical Work. *Electrician,* 108. *pp.* 361–362, *March* 11, 1932.—The application of h.f. electrical energy for therapeutic and surgical purposes, under the term diathermy, is briefly discussed. Until recent years the necessary h.f. energy has been produced by means of an excitation circuit comprising an inductance, capacity and spark gap, delivering energy to a coupled circuit into which the human subject was inserted. Of recent years the thermionic valve method of exciting h.f. oscillations has been applied to electro-medical purposes. It is claimed that by this method, as compared with the spark-gap method, there are advantages as respects a greater available power, silent operation and obviation of the need of cleaning and adjusting the spark-gap. It is also claimed that involuntary muscular contraction, which has hitherto been of practical objection, when the current was used for cutting purposes, is overcome. It is stated that the frequency of oscillation of the apparatus is of less importance than the wave-form, the damping and regularity of operation. A particular instrument which has been given the trade name of "Chirotherm" is illustrated and briefly described. B. J. L.

3464. Biological Effect of Cosmic Rays. G. Lakhovsky. *Accad. Lincei, Atti,* 15. *pp.* 403–405, *March* 6, 1932.—Refers to the experiments of V. Rivera, which show a greater speed of development of seeds with increasing depth below the surface of the lake of Catelgandolfo, near Rome, and attributes this effect to the weakening of the cosmic rays by the water. The author confirms this, but maintains that a similar effect can be produced by electromagnetic fields produced by oscillations, including those of light. He proposes to surround living beings with such protective screens and thus increase their vitality. He attributes the longevity of deep-sea fish to this cause. E. E. F. d'A.

3465. Biological Effects of Short Waves. H. Bordier. *Comptes Rendus,* 194. *pp.* 1191–1193, *April* 4, 1932.—Describes experiments on the effect of h.f. waves of periodicity about 30,000,000 ∼ (10 m. wave-length) on certain fish in water. It was first established that fish die when the temperature of the water exceeds 30° C. The tank containing the water and live fish was then put between the plates of a condenser passing h.f. current, and the fish were found to die at a water temperature of 25° C. It is concluded that h.f. vibrations produce a biological effect other than that due to the resulting rise in temperature. G. E. B.

3466. Physics of Ultra-Short-Wave Therapy. Wave Band of Selective Heating. J. Pätzold. *Zeits. f. techn. Physik,* 13. 5. *pp.* 212–216, 1932.—In the case of short-wave therapy, as distinct from ordinary diathermy, the current does not distribute itself according to Kirchhoff's laws, but in a manner comparable with the distribution in a condenser, of which the body-tissue constitutes the dielectric. Heating is brought about by the dielectric losses, and there is no metallic connection between the electrodes and the tissue. The therapeutic effects of the application of short waves of various wave-lengths are examined, and it is concluded that the optimum wave-length depends to some extent on the kind of tissue, and varies from 0·79 to 17·7 m., there being a connection between the optimum wave-length and the resistance of the various tissues. G. E. B.

3467. Periodic Fluctuation of the Electric Field of the Human Body. W. E. Boyd. *Brit. J. of Radiology,* 5. *pp.* 362–367, *April,* 1932.—Reports the continuation of research upon the electric fields surrounding the human body, which have previously been investigated by the author, by means of a specially built laboratory constructed on the Faraday cage principle [see Abstract 2940 (1930)]. The previous methods of investigation have been improved by the construction and use of special instruments for the measurement of the electrical potentials. This measuring apparatus was electrically screened and employed a high-resistance grid leak for the first amplifying valve of the apparatus, which is closely described. This grid leak was controlled by means of a potassium gas photoelectric cell, reacting in relation to the intensity of light thrown upon the cell. An attempt was made to obtain simultaneous electrocardiographic and potential records, but this was impossible owing to the attachment of the electrocardiograph skin pads upsetting the static arrangement. Records were therefore taken separately, but immediately after each other, and showed that the periodicity of the static potential and the electrocardiograph current change was the same, although proof as to the actual synchronicity was wanting. Further experiments were made to ascertain whether the static potential change was due to the friction of arterial blood in the subject's arteries or to skin conduction from the region of the heart, and it is concluded that the potentials originate mainly from the heart itself. The distribution of static changes of potential over the body surface was also investigated and the result was unexpected. It was assumed that the changes would become less marked over those parts of the body nearest to the earth, but, whilst this was found to be the case, if the subject's feet were insulated and the upper body earthed, the effect of the earth's potential did not appear to be of the utmost importance. It is therefore proved that not only is the human body surrounded by a varying electrical field, but the distribution of surface intensity varies considerably according to the electrical relationships of the body. The author therefore considers that the intimate study of the potentials of the human body may materially aid the development of physical methods of treatment as distinct from the applications of electrical radiative methods, which form, at present, the more extensive applications of electro-medicine. B. J. L.

CHEMICAL PHYSICS AND ELECTROCHEMISTRY.

3468. Adsorption of Gases by Solids. *Faraday Soc., Trans.* 28. *pp.* 131–194, *March*; 195–409; *Disc., pp.* 410–447, *April*, 1932.—A general survey of the subject comprising 39 papers arranged under three main headings, and preceded by a General Introduction and followed by a General Discussion in which various contributors participated, as follows:—

" General Introduction," by **H. S. Taylor** (pp. 131–138).—A general review of the subject of adsorption at the gas-solid interface in which the following topics are discussed: the adsorption isotherm, mobility in the adsorbed layer and the nature of the adsorption process. Two types of adsorption are distinguished, the first, due to van der Waals forces, which is reversible and characterised by a low heat of adsorption, and the second, called activated adsorption, which is not reversible and which possesses a high heat of adsorption. Activated adsorption is so called because it occurs with a measurable velocity which increases as the temperature is raised, which implies that the adsorption process involves an activation energy. For activated adsorption not only coulombic forces but also non-classical interchange energies between adsorbent and adsorbate are operative.

SECTION I. EXPERIMENTAL METHODS.

" Introductory Paper," by **E. K. Rideal** (pp. 139–147). A summary of many of the problems met with in the experimental study of adsorption, such as methods of revealing the presence of adsorbed or absorbed gases, rates of sorption and surface migration, and the measurement of the accommodation coefficient. The methods of determining the specific area of a solid surface are summarised critically.

" Use of Thermionics in the Study of Adsorption of Vapours and Gases," by **J. A. Becker** (pp. 148–158). The technique employed in the application of thermionics to the experimental study of the adsorbed layer is described. Minute amounts of adsorbed electropositive elements such as cæsium or thorium, or electronegative gases such as oxygen, change the thermionic emission from tungsten, platinum, etc., by altering the work function of the surface. This is explained as a result of the partial ionisation of the adsorbed layer which then acts as a positively charged, open-meshed grid placed close to the surface. From this basis it is shown that (1) the extent of ionisation in the adsorbed layer decreases as the surface concentration increases, (2) the work required to remove an adsorbed ion from the surface increases while the work required to remove an adsorbed atom decreases as the surface concentration increases, (3) the mean life of an adsorbed particle depends on the surface concentration as well as the temperature, and (4) the rate of diffusion from the surface into the interior depends upon the temperature and the amount by which the surface concentration exceeds its equilibrium value.

" Adsorption of Saturated Vapours by Porous Substances. Experimental Methods," by **F. G. Tryhorn** and **W. F. Wyatt** (pp. 158–161). A summary of methods already described [see Abstract 1064 (1928)].

" Pressure Measurements for Investigating the Mutual Behaviour of Adsorbed Hydrogen Atoms," by **M. C. Johnson** (pp. 162–165). [See Abstracts 256, 634 and 3983 (1931).]

" Mixture Isotherms at Active Points," by **H. Dohse** and **H. Mark** (pp. 165–169). The catalytic decomposition of isopropyl alcohol on bauxite is poisoned by the water formed. From a study of the rate of decomposition when water is present and when it is removed it is possible to derive the amounts of alcohol and water adsorbed on the active centres of the bauxite from a gas phase consisting of a mixture of water and isopropyl alcohol.

" Behaviour of Adsorbed Atoms," by **J. Chariton, N. Semenoff** and **A. Schalnikoff** (pp. 169–176). The theory of the condensation of molecular rays at solid surfaces as developed by Chariton and Semenoff [see Abstract 2550 (1924)] indicated that, for a given density of the condensing molecular stream, a critical temperature of the condensation exists, above which no condensation would occur. A study of the condensation of mercury and cadmium on glass, or glass covered with naphthalene or sulphur, indicates that the critical temperature of condensation is not so sharp as is generally supposed. Deposits can be obtained above the " critical temperature " if sufficient time is allowed. The lack of sharpness is attributed to the inhomogeneity of the surfaces used: active points will possess a critical temperature lower than that for the surface on the average. Using the Brownian movement formula, an attempt is made to calculate the rate of migration of adsorbed atoms along the surface.

" Thickness of Adsorbed Films on Mercury," by **H. Cassell** (pp. 177–179). The results of a study of the surface tension of mercury in an atmosphere of superheated benzene indicate a step-by-step rise in the surface density of the adsorbed benzene layer [see Abstract 247 (1932)]. This is interpreted to correspond with the formation of successive layers of adsorbed material. Owing to the dissymmetry of the benzene molecule the point has now been investigated using carbon tetrachloride. Similar results are obtained. The greatest surface density found was equivalent to a layer 3·6 molecules thick.

" Sorption of Gases by Glass," by **F. P. Burt** (pp. 179–184). The ammonia-glass system has been studied. It is concluded that in order to minimise sorption errors in density and compressibility measurements the glass surface should be exposed to the experimental gas for a considerable time at the highest pressure that is to be used.

" Rôle of Surface Adsorption in Chain Reactions," by **C. N. Hinshelwood** (pp. 184–191). Chain reactions may proceed either with a steady velocity or explosively. The influence of the walls of the reaction vessel is considered in both cases. In the first, the following types are classified: (1) chains which originate at the walls, (2) chains which originating at the walls are also broken there and (3) chains originating in the gas phase which are broken at the walls. Chains may be broken at walls by either a chemical or a physical deactivation or both; the first type is most common. The different ways in which the walls of the reaction vessel can influence the explosion limits are discussed.

" Criticism of Experimental Evidence for Activated Adsorption," by **L. J. Burrage** (pp. 192–194). The author suggests that the measurements of the activation energy of the activated adsorption process are unreliable because insufficient precautions have been taken to clean the adsorbing surfaces.

SECTION II. KINETICS AND ENERGETICS OF GAS ADSORPTION.

"Introductory Paper," by **H. Freundlich** (pp. 195–201). An historical summary.

"Adsorption and Solution of Gases by Metals," by **A. F. Benton** (pp. 202–218). The adsorption isotherms in the following systems have been measured: Cu–N_2, Cu–H_2, Cu–CO, Fe–N_2, Fe–CO, Fe–H_2, Ni–H_2, Ag–O_2. In analysing the results, three different processes are distinguished, (1) physical adsorption, (2) activated adsorption and (3) solution. No simple rule can be given with which it is possible to identify the nature of a given sorption process: identification is only possible after extended experimental investigation. The principal characteristics of the three types are outlined. It is suggested that activated adsorption is a preliminary to the formation of definite chemical compounds and to solution.

"Discontinuities in Adsorption Processes," by **A. J. Allmand, L. J. Burrage** and **R. Chaplin** (pp. 218–222). Evidence, already published [see Abstracts 1015, 1016, 2064, 2821, 3611 (1931) and 2159 (1932)], concerning the discontinuous nature of adsorption isothermals is summarised. Further data are given for the adsorption of carbon dioxide, water, methyl alcohol, carbon tetrachloride and sulphur dioxide on charcoal and silica gel. The isothermals above 0·1 mm. appear to consist of sharply defined rectangular steps. Further, with carbon tetrachloride the quantity increments between successive steps are practically constant over the whole pressure range covered by the experiments, *viz.*, 8–0·1 mm. With water vapour the increments are constant when starting at higher pressures, increasing at intermediate pressures and falling off again as the pressure is reduced. Discontinuities are absent at pressures less than 0·1 mm.

"Possible Connection between Activated Adsorption and Gas Displacement Effects," by **A. J. Allmand** and **R. Chaplin** (pp. 223–226). It is suggested that the energy of activation of activated adsorption is the energy of activation of the process by which small traces of foreign gases are displaced from the adsorbate by the adsorbent.

"Kinetics of Adsorption in Relation to Reaction Velocity," by **F. H. Constable** (pp. 227–228) [see Abstracts 1411 and 2224 (1928)].

"New Experiments on the Mechanism of the Catalysis of Ammonia on Tungsten," by **W. Frankenburger** and **A. Hodler** (pp. 229–242). The adsorption of hydrogen, nitrogen and ammonia on tungsten has been measured. The catalytic activity of a given sample of tungsten may be defined by measuring the adsorptive power for hydrogen. The influence of temperature on the amount of hydrogen adsorbed by tungsten possesses those characteristics attributed by Taylor to activated adsorption. The adsorption of ammonia has been measured at temperatures of 20°–60° C. over the pressure range of 5×10^{-3} to 0·2 mm. At low pressures the adsorption obeys Henry's law; at intermediate pressures the adsorption is less than that corresponding to Henry's law: at the highest pressures the rate of increase of adsorption with pressure increases again, indicating condensation in the adsorbed layer. Hydrogen and ammonia are adsorbed from mixtures on tungsten independently of one another. Tungsten covered with relatively large quantities of nitride and imide from the decomposition adsorbed more hydrogen and nitrogen than a clean surface. The added ammonia so adsorbed is not decomposed catalytically. The admission of successive small amounts of ammonia to a fresh tungsten powder at temperatures between 90° and 250° showed that the first amounts decomposed bimolecularly, the middle and final fractions either monomolecularly or not at all. The bimolecular process is attributed to nitride formation and the monomolecular to imide formation. Both have the same energy of activation.

" Adsorption and Reflection Processes in the Interaction of Hydrogen and Metals," by **K. F. Bonhoeffer** and **A. Farkas** (pp. 242–247). The accommodation coefficient of hydrogen on nickel increases discontinuously at a given hydrogen pressure. The pressure at which this occurs is dependent upon the temperature. A similar discontinuity appears in the catalysis of the para-hydrogen conversion, the catalytic activity decreasing discontinuously at the same point as the break in the accommodation coefficient-pressure curve. This critical pressure is assumed to be that at which the pressure in the adsorbed layer reaches that of the decomposition pressure of the hydride. *Correction*, *ibid*., p. 561, July, 1932.

" Activated Adsorption of Hydrogen and the Para-Hydrogen Conversion," by **H. S. Taylor** and **A. Sherman** (pp. 247–253). The adsorption of hydrogen and the catalytic activity of nickel, zinc oxide, zinc-chromium oxide, manganous-chromium oxide, copper-chromium oxide and alumina have been measured and compared. Surfaces at which activated adsorption occurs show a parallel efficiency in effecting the ortho-para-hydrogen conversion. No such parallelism exists between van der Waals adsorption and catalytic activity. Charcoal shows a decreasing efficiency in converting para- to ortho-hydrogen with increasing temperature. The surface reaction appears to be bimolecular, and as the amount adsorbed decreases with increasing temperature, the decrease in the bimolecular velocity constant is to be expected.

" Kinetics of Adsorption of Hydrogen on Platinum and Nickel," by **E. B. Maxted** and **N. J. Hassid** (pp. 253–261). The total adsorption has been separated into a fast primary and a slow secondary adsorption. For hydrogen on platinum the primary adsorption decreases linearly with increase of temperature. The secondary adsorption, on the other hand, shows a maximum at about 100° C. With nickel, however, both the primary and secondary adsorption showed maxima. In this case the amount of secondary adsorption was greater than for platinum and the kinetics of the process could be studied. The rate of secondary adsorption followed an approximately logarithmic path.

" Heats and Kinetics of Adsorption," by **W. E. Garner** (pp. 261–269). A discussion of the heats and kinetics of the adsorption of three types of adsorbed layer: van der Waals, reversible chemi-sorption and irreversible chemi-sorption.

" Adsorption of Hydrogen by Charcoal," by **F. E. T. Kingman** (pp. 269–272). The rate of adsorption of hydrogen by charcoal has been studied at temperatures between 400°–530° C. The rate is found to be proportional to the pressure and the extent of the available surface. The critical increment is 30,000 cal.

" Sorption of Hydrogen by Platinised Charcoal," by **R. Burstein** and **A. Frumkin** (pp. 273–275). Unplatinised charcoal containing adsorbed oxygen keeps its oxygen in an atmosphere of hydrogen. Charcoal promoted by platinum loses its oxygen [see Abstract 3985 (1931)]. It is now shown that platinum catalyses the sorption of hydrogen by charcoal.

" Occlusion of Hydrogen by Palladium. Part I," by **A. R. Ubbelohde** (pp. 275–283). Assuming that hydrogen enters the palladium lattice as atoms, equations are given for the velocity of this process under various

V.3
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experimental conditions. Since the velocity of adsorption depends upon the rate of the slow reaction $H_2 \rightarrow 2H$ and the velocity of desorption on the rate of the relatively rapid reverse reaction, a simple explanation is obtained for the fact that equilibrium is much more rapidly attained on desorption than on adsorption. The different factors influencing the velocity of occlusion are also discussed.

"Occlusion of Hydrogen by Palladium. Part II," by **A. R. Ubbelohde** and **A. Egerton** (pp. 284–291). The removal isothermals of the hydrogen palladium system were determined at temperatures between 100° C. and 306° C. A single value for a, the fraction of impinging molecules adsorbed is calculated for each temperature, and the relative influence of the activation energy and the number of active points on a is determined. A flat part of the isothermals was only observed at 100° C., and by varying the activity of the palladium or the time of exposure to hydrogen the "flat part" can be both completely eliminated or made to approach the maximum value.

"Influence of Nuclear Spin on the Sorption of Hydrogen on Charcoal," by **A. R. Ubbelohde** (pp. 291–299). Hydrogen freshly desorbed from charcoal at the temperature of liquid oxygen contains more ortho-hydrogen than the equilibrium mixture. It is suggested, therefore, that ortho-hydrogen is more easily adsorbed than para-hydrogen at this temperature. No definite change in the relative adsorption could be found when hydrogen was continuously removed over the range of pressures 25–7 cm.

"Explosive Combination of Hydrogen and Oxygen—Function of Walls in Gaseous Reactions," by **H. W. Thompson** (pp. 299–308). The influence of temperature, dimensions of reaction vessel and inert gases on the lower limiting pressure of the critical explosion region of hydrogen-oxygen mixtures has been studied. The explosion was caused by a spark and therefore the reaction chains were generated in the gas phase. The results show that for the continued propagation of such reaction chains it is necessary that they should not strike the walls. Inert gases cause more effective propagation of chains by reducing the rate at which they reach the walls.

"Oxidation of Phosphorus Vapour at Low Pressures," by **H. W. Melville** (pp. 308–315). A deduction of the equation

$$p_{P_4} \cdot p_{O_2}(1 + p_x/D(p_{P_4} + p_{O_2})) = \text{constant},$$

where p_{P_4}, p_{O_2} and p_x are the pressures of phosphorus, oxygen and inert gas respectively and D is the coefficient of diffusion of oxygen through the inert gas. A critical discussion is also given of the influence of phosphine and ozone on the critical explosion limits of phosphorus-oxygen mixtures.

SECTION III. THEORIES OF THE ADSORPTION OF GASES.

"Introductory Paper," by **M. Polanyi** (pp. 316–333). A discussion of adsorption from the point of view of electrostatic, valence and dispersion forces. Electrostatic forces play only a very small part in the adsorption of neutral molecules. Valence forces probably give rise to activated adsorption. Dispersion or van der Waals forces are responsible for the type of adsorption which is rapid and reversible. Capillary condensation is also discussed. The form of the adsorption isotherm is discussed in its relation to surface concentration and surface inhomogeneity.

"Processes of Adsorption and Diffusion on Solid Surfaces," by **J. E. Lennard-Jones** (pp. 333–359). The adsorption of an atom at a metallic surface by van der Waals forces is treated quantitatively. It is shown that the potential energy of the atom W is equal to μR^{-3}, where R is the distance of the atom from the surface and μ is given by $mc^2\chi/L$; χ is the magnetic susceptibility per gm. atom, m the mass of the electron, c the velocity of light and L Loschmidt's number. In order to calculate the heat of adsorption it is necessary to determine the value of R at which the atom is in equilibrium with the surface. Rough estimates are made of this distance and the values of the heats of adsorption obtained are reasonable. Similar calculations are carried through for argon at a potassium chloride crystal with the addition that here the repulsive forces can be calculated and the equilibrium value of R determined. The potential field reaches its minimum above the centre of a lattice cell and the heat of adsorption at this point is 1600 cal. The heat of adsorption of neon on sodium fluoride is similarly calculated to be 500 cal. "Activated adsorption" is assumed to occur when the cohesion between the individual atoms of the adsorbing molecule and the metal is greater than the heat of dissociation of the molecule. This model is discussed and it is shown that such a process requires an activation energy. Further, at both low and at high temperatures the probability of adsorption as atoms is small. The slow sorption of hydrogen by copper, studied by Ward [see Abstract 996 (1932)], is also considered. It is assumed that the hydrogen is adsorbed as atoms, a certain fraction of which at any given time possesses sufficient energy to diffuse laterally across the surface. The main experimental results of Ward are explained, and it is calculated that the average distance traversed by one adsorbed atom per sec. is about 10^{-5} cm.

"Migration of Adsorbed Molecules on Surfaces of Solids," by **M. Volmer** (pp. 359–363). A summary of the literature.

"Deviations from the Ideal Translational Motion of Adsorbed Molecules," by **M. G. Evans** (pp. 364–368). A discussion of the effect of surface inhomogeneities on the lateral movement of adsorbed molecules.

"Quantum Mechanics of the Reversible Electrolytic Cell and of Electrolysis," by **R. H. Fowler** (pp. 368–378). A summary of the recent work of Gurney [see Abstract 1462 (1932)] and subsequent work to be published shortly.

"Mechanism of Overvoltage and its Relation to the Combination of Hydrogen Atoms at Metal Electrodes," by **J. A. V. Butler** (pp. 379–382). A modification of the work of Gurney to take account of the rate at which electrons are returned to the electrode by hydrogen atoms. It is then shown that the overvoltage should vary linearly with the current density at very small values of the latter. This prediction is confirmed experimentally.

"Theory of Heat Evolved in Capillary Condensation," by **E. Hückel** (pp. 382–386). The heat of condensation in capillaries will differ from the ordinary heat of condensation for three reasons: (1) condensation in capillaries reduces the size of the liquid/vapour interface; an amount of surface energy is thus set free which is proportional to the surface energy and the diminution of the surface; (2) owing to the curvature of the liquid/vapour interface the pressure in the liquid differs from the saturation pressure for a plane surface, and (3) during condensation the mean curvature of the interfaces diminishes and therefore the pressure in the liquid already sorbed will increase, setting free compression energy as heat. The heat of condensation is calculated on this basis and applied to the results of Williams for the adsorption of sulphur dioxide on charcoal.

"Electrical Theory of Gaseous Adsorption," by **A. Magnus** (pp. 386–394). Adsorption of the van der Waals type is treated according to the Debye theory of van der Waals forces. From consideration of the adsorption isotherms and of the decrease in the heat of adsorption which accompanies increase in the amount adsorbed it is concluded that adsorbed molecules repel each other. This is to be expected from the above theory since the adsorbed layer is made up of a set of dipoles arranged parallel to one another. It is suggested that ionic lattices may cause adsorption to take place by inducing electric moments in gas molecules.

"Interchange of Energy in Collisions between Gas Atoms and Solid Surfaces," by **J. K. Roberts** (pp. 395–398). The accommodation coefficients of helium against tungsten surfaces which have been cleaned carefully decreases as the temperature is lowered. The temperatures studied were lower than room-temperature. The results are explained by assuming the solid to be a set of Planck oscillators of the same frequency. At temperatures at which the mean thermal energy is less than $h\nu$ a considerable number of the solid atoms are in the ground state and the only possible interchange is that the gas atom should give up an energy of $h\nu$ to the solid atom. The number of gas atoms having this energy becomes less and less as the temperature is lowered, and therefore the accommodation coefficient is decreased as the temperature falls.

"Suggested Existence of Activated Adsorption," by **A. F. H. Ward** (pp. 399–405). The sorption of hydrogen by copper has been studied. It is suggested that all the observed facts can be explained in terms of the solution, *i.e.*, absorption of the hydrogen on the walls of the grains in the interior of the copper which are not directly accessible to the gas phase. The objections raised by Taylor are discussed. It is shown from measurements of the adsorption and rate of solution at a series of temperatures that both the rate of solution and the solution are proportional to the amount of gas adsorbed on the surface.

"Hydrogenation of Adsorbed Ethylenic Hydrocarbons," by **C. Schuster** (pp. 406–408). A discussion of the adsorption of ethylenic hydrocarbons and hydrogen on charcoals and of the catalysis of the reactions between them.

"Persorption and Monomolecular Sieves," by **J. W. McBain** (pp. 408–409). Many solids such as chabasite act as molecular sieves. In order to describe the permeation of solids of this type by molecules of the sorbed substance, the term persorption is suggested. F. J. W.

3469. Gibbs' Adsorption Equation for Binary Mixtures. R. K. Schofield and E. K. Rideal. *Phil. Mag.* 13. *pp.* 806–809, *April*, 1932.—Wynne-Jones' interpretation of his results [see Abstract 1768 (1932)] is criticised as overlooking the importance of the imaginary "dividing surface" in relation to Gibbs' theory. There must be below the (surface) alcohol layer a corresponding one of water adsorption, the adsorption in which, calculated from previous data, increases approximately linearly to $8 \cdot 3$ moles per 10^{10} cm^2 of water for a mixture containing 65 % water [see Abstract 2412 (1925)]. There is also no theoretical foundation for the relation $U = \Gamma + kc$, where U is the number of moles per 10^{10} cm^2 of alcohol in the alcohol adsorption layer. C. A. S.

3470. Methyl Red as an Adsorption Indicator. G. Batchelder and V. W. Meloche. *Am. Chem. Soc., J.* 54. *pp.* 1319–1323, *April*, 1932.—A precipitation titration of sulphate by means of barium chloride is described. The procedure is not satisfactory for the quantitative determination of sulphate, but it is used, together with a more precise titration of fluoride with cerous nitrate, to illustrate the application of methyl red to adsorption titrations. Methyl red is regarded as an acid indicator which detects the change of pH at the end-point of two precipitation titrations, the change being attributed to adsorption during the titrations. T. H. P.

3471. Adsorption of Gases by Copper. A. F. Benton and T. A. White. *Am. Chem. Soc., J.* 54. *pp.* 1373–1390, *April,* 1932.—The adsorption of gases by copper was studied by admitting a known volume of gas into an evacuated bulb containing the copper, and noting the pressures produced as a function of time until equilibrium was reached. The gases used were N_2, H_2 and CO, and the measurements were carried out at temperatures down to 78° Abs. Three processes were recognised, (*a*) surface adsorption of a physical type, (*b*) surface adsorption of the activated type, and (*c*) solubility. N_2 showed only physical adsorption, and H_2 exhibited all three processes. The amount of H_2 taken up in each of the three ways was determined. CO showed three processes, two of which were shown to be physical and activated adsorption, and the third was either solubility or a second kind of activated adsorption. F. J. B.

3472. Orientation of Molecules in Relation to the Problem of Wetting. P. Woog. *Kolloid Zeits.* 59. *pp.* 1–6, *April,* 1932.—The author has given consideration to the importance of the surface film, molecular solutions, the movements of oil drops sliding on a film of orientated molecules, the effects of mechanical forces on the orientation, the particular importance of the surface film with reference to semi-fluid friction and the definite time needed for orientation to be attained. J. K.

3473. Influence of Particle Size on the Heat of Wetting of Powdered Adsorption Substances. Part II. F. Krczil. *Kolloid Zeits.* 59. *pp.* 44–46, *April,* 1932.—The author has established that the heat of wetting only increases as particle-size diminishes to a certain definite limit which is characteristic for each absorbent. [For Part I see Abstract 2614 (1932).] J. K.

3474. Liquid-Vapour Interface. J. L. Shereshefsky. *J. Phys. Chem.* 36. *pp.* 1271–1278, *April,* 1932.—Theories are used to find what is the structure of the surface of a liquid under its own vapour. It is suggested that there is an adsorbed layer of vapour, of density intermediate to those of the liquid and normal vapour and of about molecular thickness as calculated from the Maxwell–Boltzmann law. It is shown that at corresponding temperatures the molar adsorption is the same for all liquids. Tables give the adsorption, thickness and density of the adsorbed layer for a liquid benzene surface. H. M. B.

3475. Application of Dühring's Relation to Solubilities. R. L. Harris. *Indust. and Engin. Chem.* 24. *pp.* 455–457, *April,* 1932.—If the temperatures at which one substance exerts certain pressures be plotted against those at which a reference substance exerts the same vapour pressures, the points are found to lie nearly on a straight line. Hence, if the vapour pressure of a substance be known at two points, a straight line may be drawn in accordance with Dühring's relation, the complete vapour-pressure data for some reference substance being known. As the ideal case of solution is quite analogous to that of vaporisation, it seemed likely that Dühring's relation should apply also to solubility curves. For inorganic salts dissolved in water, this is found to be actually the case.

T. H. P.

3476. Influence of Boundary Surfaces on the Velocity of Crystallisation. K. Söllner. *Kolloid Zeits.* 59. *pp.* 58–60, *April,* 1932.—Under some circumstances the velocity of crystallisation in the surface of a supercooled liquid may be greater than in the interior of the liquid. This fact is explained by assuming the existence of layers of orientated molecules in the surface. The increased velocity of crystallisation to be expected in the surface of solutions of capillary-active substances is discussed and compared with the known increased velocity of liberation at boundary surfaces. It is suggested that, like other boundary surfaces, that adjacent to the gaseous space is the seat of enhanced probability of nucleus-formation. T. H. P.

3477. Cause of the Influence of Admixtures on the Rapid Setting of Gypsum Cement. de S. Yamane. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 358. *pp.* 101–108, *April,* 1932. *In Esperanto.*—The influence of sodium chloride, ammonium sulphate and sodium sulphate on the rate of setting of gypsum cement has been examined by a calorimetric method in which time-temperature curves are determined for various mixtures of the cement with water and with solutions (about 1 %) of the salts studied. Sodium sulphate has the greatest accelerating action, which is, however, little less than those of the other two salts. Measurements have been made of the conductivities of solutions of calcium sulphate in contact with the solid phase; with commercial calcined gypsum the conductivity rises for the first 5 min., remains constant for about 25 min., and then falls slowly, as a result of the formation and subsequent deposition of the dihydrate. With pure calcium sulphate the initial rise of conductivity does not occur, whilst with the pure material in contact with solutions of the three salts the conductivity is constant for only a short time and the subsequent fall takes place rapidly. The solubilities of the hemi- and di-hydrates in water and in solutions of the salts have also been determined. The results are discussed in their relation to the acceleration of the setting of gypsum cements. H. F. G.

3478. Dielectric Behaviour of Disperse Systems. A. Piekara. *Kolloid Zeits.* 59. *pp.* 12–25, *April,* 1932.—It is shown that the dielectric data of the inner and outer phases are not in good agreement with the extended Clausius–Mossotti formula, especially for fine-particle emulsions. The mutual influence of the spherical particles changes the dielectric constant of the whole system, and although proportional to the volume it is not explicitly dependent on the degree of separation. The relationship between the dielectric constant of emulsions and the degree of dispersion is a consequence of the boundary layer processes, *viz.*, modified molecular field, absence of spherical symmetry and adsorption. H. H. Ho.

3479. Osmosis and Solvation of Disperse Systems. Wo. Ostwald. *Zeits. f. phys. Chem.* 159. *Abt.A.* 5. *pp.* 375–392, *April,* 1932.—A short review is given on a number of investigations carried out on this subject by the author and co-workers during the past twenty years. The osmotic pressure measured in the cell can be derived from the van't Hoff pressure (linear concentration function), the solvation and also the swelling pressure. For the latter a parabolic relationship exists. The equation $P = c\frac{RT}{M} + kc^n$ has been found to apply extremely well to concentrated molecular systems (compare the measurements of Morse, Berkeley, Hartley) as well as to hydro- and organosols (isoelectric gelatin, hæmoglobin, nitrocellulose, rubber, etc.), and in the reduced form to the swelling of gels (Posnjak, Freundlich). The exponent value is usually ~ 2. As a physical explanation of the equation, two kinetic deductions of W. Haller are given. It is also shown that the equation can be deduced thermodynamically. J. K.

3480. Spontaneous Dispersion of Small Liquid Systems under Physico-Chemical Reactions. N. v. Raschevsky. *Physics*, 2. *pp*. 303–308, *April*, 1932.—The treatment of the problem which was given in previous publications [see Abstract 619 (1932)] is generalised so as to include not only the part played by the changes of the surface tension, but also that played by osmotic forces. Whenever any reactions take place in a liquid drop of the kind considered previously, there is always a difference of concentration inside and outside of the drop. The forces caused by this difference are such that they always tend to divide the drop. The surface tension counteracts this tendency. As a result of this, the drop will divide only above a critical size. Calculations of this critical size lead to dimensions of actual living cells. AUTHOR.

3481. Individual Diffusion of Liesegang Reagents in Gelatin. Suzanne Veil. *Comptes Rendus*, 194. *pp*. 1155–1157, *April* 4, 1932.—The aureole formed by a drop of solution of potassium dichromate on gelatin shows no discontinuity; that formed by silver nitrate shows turbidity which decreases parabolically and is sometimes stratified [see Abstract 2477 (1931)]. Adjacent drops on meeting produce complicated lines, as though the dichromate pushed back the silver nitrate. An electric field deforms the aureole of the dichromate as though it were attracted by the anode, that of the silver nitrate in the opposite way. C. A. S.

3482. Influence of Low Temperature on Colloid Systems. S. I. Djatschkowsky. *Kolloid Zeits*. 59. *pp*. 76–81, *April*, 1932.—The author has found that in those colloidal solutions which approach electrolytes, *e.g.*, peptised hydroxides, and which after melting develop precipitates, the coagulated portion gives up its electrolytes to the intermicellar fluid. According to the author, all colloidal solutions with reference to lowering of temperature can be divided into two classes. To one class belong the sols which do not freeze at −5°, −15° or −21°. The solutions of these sols have a pH value $< 8\cdot5$. To the second class belong those sols which freeze uniformly throughout. Their solutions have a pH value of $> 8\cdot5$. [See Abstract 2831 (1931).] J. K.

3483. Viscosity of Gelatin Sols in Relation to Concentration. H. Bincer. *Kolloid Zeits*. 59. *pp*. 82–87, *April*, 1932.—The author has investigated the applicability of the Fikentscher–Mark viscosity formula for gelatin sols and has found that the viscosity of gelatin solutions increases faster with increase in concentration than corresponds with the formula. J. K.

3484. Rôle of Water in Gelatin Sols and Gels. H. Bincer. *Kolloid Zeits*. 59. *pp*. 88–93, *April*, 1932.—It is shown that agreement exists in the degree of solvation of gelatin sols whether determined according to the Fikentscher–Mark solvation theory or calculated from the equilibrium data of Eggert and Reitstötter. The dependence on temperature of the degree of solvation of gelatin sols is confirmed. J. K.

3485. Extinction Coefficients of the Silicic Acid Gel-Forming Mixtures. M. Prasad, S. M. Mehta and J. B. Desai. *J. Phys. Chem.* 36. *pp.* 1324–1336, *April,* 1932.—The extinction coefficients of mixtures forming gels of silicic acid are measured by Hilger Nutting's spectrophotometer. It is shown that at constant concentration the micelles in gels are bigger than those in sols, and that the micelles in alkaline gels are bigger than in the acidic ones. J. K.

3486. Formation of Acetylene from Methane by the Condensed Spark at Low Pressure. P. Montagne. *Comptes Rendus,* 194. *pp.* 1490–1492, *April* 25, 1932.—Applying the method previously described [see Abstract 406 (1926)] to methane at 1–11 mm. mercury, the main reaction (to the extent of about 75 %) is $2CH_4 = C_2H_2 + 3H_2$, but complicated by subsequent decomposition and condensation of the acetylene. The energetic yield is about 15 %. The reaction is accelerated, and the yield, both chemical and energetic, is improved if the capacity of the condenser is increased. At the temperature of liquid air up to 10 % of the methane is transformed into saturated or ethylenic hydrocarbons, and the energetic yield is diminished. [See Abstract 2020 (1928).] C. A. S.

3487. Hydrazine Formation in the Synthesis and Decomposition of Ammonia. Part I. G. R. Gedye and T. E. Allibone. Parts II and III. G. R. Gedye and E. K. Rideal. *Chem. Soc., J. pp.* 1158–1172, *April,* 1932.—Part I deals with the synthesis of hydrazine and ammonia by kathode rays, small yields of both products being obtained from mixtures of nitrogen and hydrogen. Owing to the long range of such electrons in a $N_2 : 3H_2$ mixture, the method is not very suitable for quantitative investigation. Part II describes the photochemical decomposition of ammonia by the total radiation from a quartz-mercury arc, a flow method being employed. The formation of hydrazine has been proved by a determination of the percentage composition and molecular weight of the condensable product formed. The relative yield of hydrazine is favoured by low temperature of the reaction vessel, high flow-rate and rapid cooling of the gases leaving the reaction vessel. Under the optimum conditions the yield may represent over 50 % of the decomposed ammonia. Very little hydrazine is obtained in the mercury-sensitised decomposition. The decompositions of ammonia by light and ionising radiation are discussed and compared. Part III discusses the synthesis of hydrazine at catalytic surfaces. Hydrazine, as well as ammonia, is formed by the union of nitrogen and hydrogen on an iron catalyst promoted with the oxides of aluminium and potassium. The relative yield of hydrazine is greater at lower temperatures and is approximately 4 % by weight at 437° C. H. H. Ho.

3488. Ignition of Detonating Gas by Hydrogen Atoms. F. Haber and F. Oppenheimer. *Zeits. f. phys. Chem.* 16. *Abt.B.* 6. *pp.* 443–460, *April,* 1932.—Admixtures of H atoms are able to cause explosion of mixtures of H_2 and O_2 at pressures between 30 and 150 mm. and temperatures of about 300° C. Where the pressure was above 80 mm., no cause of the explosion other than the presence of the H atoms was evident. Under the experimental conditions used, increase of the pressure—which renders ignition by the walls of the vessel more difficult—makes explosion by the H atoms easier, presumably owing to the increased H atom content at the higher pressures. The percentage of H atoms in the gases at 100 mm. pressure was found to be $2 \cdot 10^{-4}$ [see Farkas, Abstract 1420 (1931); Geib and Harteck, Abstract 3709 (1931)]. T. H. P.

3489. Entropy of Steam, and the Water-Gas Reaction. A. R. Gordon and C. Barnes. *J. Phys. Chem.* 36. *pp.* 1143–1151, *April,* 1932.—The entropy of saturated steam for 300° and of superheated steam at 1 atmosphere from 400° to 1200° is calculated, using the rotational levels for an asymmetrical rotator and the spectral constants of Mecke. In conjunction with the calculated entropies of hydrogen, carbon monoxide and carbon dioxide, the equilibrium constant of the water-gas reaction for the range 600°–1200° is then calculated. Tables of data are included. H. H. Ho.

3490. Quantum Yield of the Photochemical Decomposition of Diazoacetic Ester. E. Wolf. *Zeits. f. phys. Chem.* 17. *Abt.B.* 1. *pp.* 46–67, *April,* 1932.—The absorption spectrum and dipole moment of diazoacetic ester in solution are recorded as well as the quantum yield of its photochemical decomposition and some light-filter combinations for the ultra-violet. H. H. Ho.

3491. Photo-Decomposition of Chlorine Dioxide Solutions. E. J. Bowen and W. M. Cheung. *Chem. Soc., J. pp.* 1200–1207, *April,* 1932.—The main products of the photochemical decomposition of aqueous solutions of ClO_2 are $HClO_3$ and HCl in equimolecular proportion, the quantum efficiency rising from 0·2 at 4360 Å. to 1·0 at 3000 Å. These results may be explained by making use of the observation that ClO_2 in the gaseous state exhibits the phenomenon of predissociation at 3753 Å. The primary process probably is therefore $ClO_2 + h\nu \rightarrow ClO_2^{\times} \rightarrow ClO + O$. In contrast with the behaviour observed with ClO_2 in the gaseous phase or in CCl_4 solution, the ClO molecule apparently does not attack other ClO_2 molecules. This is probably because it combines with water to give an acid, $ClO + H_2O \rightarrow H_2ClO_2$. If this compound is assumed to react with more ClO thus, $H_2ClO_2 + ClO \rightarrow HClO_3 + HCl$, the nature and proportion of the products are explained. In CCl_4 solution the limiting quantum efficiency is about 2, the mechanism being probably $ClO_2 + h\nu \rightarrow ClO_2^{\times} \rightarrow ClO + O$, followed by $ClO + ClO_2 \rightarrow ? \rightarrow Cl_2 + \frac{1}{2}O_2$. The influence of the solvent on the phenomenon of predissociation is discussed. T. H. P.

3492. Thermodynamic Activity in Binary Alloys. C. Wagner and G. Engelhardt. *Zeits. f. phys. Chem.* 159. *Abt.A.* 4. *pp.* 241–267, *April,* 1932.—E.m.f. measurements were made of cells consisting of fluid, binary alloys and molten salts, and from the results the thermodynamic activity of the less noble component of the system was calculated. The systems investigated were:—Pb-Bi, Sn-Bi, Tl-Bi and Mg-Pb. The values obtained for the distribution coefficients and the heat of mixing by calculation from the activity measurements were compared with values obtained by direct measurements. An attempt was made to apply van der Waals' equation of state to the binary mixtures. Measurements were made of the e.m.f. of the cells Ag-Au and Cu-Au and molten electrolytes, KCl-AgCl and KCl-CuCl, respectively. The measurements were carried out over a considerable temperature range. The values obtained were considered to approximate to the equilibrium potential. F. J. B.

3493. Sodium Amalgam Electrodes in Dilute Solutions. J. S. L. Philpot, N. L. Ross-Kane and J. H. Wolfenden. *Phil. Mag.* 13. *pp.* 795–805, *April,* 1932.—The e.m.f. of the cell NaHg_x | NaCl, aq. | AgCl | Ag was measured at 25° with 0·0001–1 *N* NaCl and NaHg_x, containing 0·005–0·03 % by weight of Na, using capillary dropping electrodes of fine and of wider bore, and an overflowing capillary electrode. To obtain the true equilibrium potential of the NaHg electrode an external current should be used for concentrations $< 0 \cdot 001\,N$; reducible impurities should be $\not> 10^{-7}$ gm.-equivalent/litre; an intermittently renewed solution, the overflowing type of electrode and a concentrated amalgam are advisable. [See Abstract 3232 (1927).] C. A. S.

3494. Rôle of Indifferent Electrode in Aqueous Solutions Containing no Definite Oxidation-Reduction Substance. N. Nekrassow. *Zeits. f. Elektrochem.* 38. *pp.* 186–199, *April,* 1932.—The oxidation-reduction potentials of solutions of H_2SO_4, HCl, HNO_3 and various organic acids, NaOH and KOH, were determined. The various solutions were saturated with air, and some fifty different electrodes were employed. The reproducibility of the electrode potentials and the effect of treatment of the electrodes on the reproducibility were investigated. The pH values of the solutions were varied and the partial pressure of the oxygen in the atmosphere surrounding the electrodes was changed, and the changes in the electrode potentials were measured. Theoretical considerations based upon the results indicate that the electrodes played an active part in the oxidation-reduction potentials measured. F. J. B.

3495. Experimental Support for Stern's Theory of the Electrolytic Double Layer. J. S. L. Philpot. *Phil. Mag.* 13. *pp.* 775–795, *April,* 1932.—Reasons are given for considering ϵ, the capacity per unit of surface at constant potential, as identical with Stern's η_0, the excess of + over − electricity at the electrode boundary [see Abstract 723 (1925)]. Measured with a dropping Hg electrode in HCl aq. (0·1–0·00005 *N*) and NaCl aq. (0·1–0·002 *N*), this quantity, *i.e.*, the charge in the double layer of a NaHg electrode in equilibrium with NaCl aq. of any concentration is $-37 \cdot 1 + 1 \cdot 29 \log a \pm 1 \cdot 5$ microcoulombs/cm.^{2}, where a is the activity of Na in an amalgam, that in a 0·1 % amalgam being unity. The capacities of the adsorbed layer for $H^{\cdot}$, $Na^{\cdot}$ and Cl' ions respectively are 23·3, 23·6 and 53·7 or 57·3 (according as measured in HCl or NaCl) mfd./cm.^{2}; the specific adsorption potentials of $H^{\cdot}$, $Na^{\cdot}$ and Cl' are all approximately −0·02 volt; the absolute potential of the Ag-AgCl electrode in 0·1 *M* NaCl is +0·47 ± 0·03 volt. The results agree with Stern's equation. C. A. S.

3496. Liquid Junction Potentials. Part I. Reproducible Static Liquid Junctions Constant in Potential over Long Periods of Time. Part II. Direct Comparison of Static and Flowing Junctions. A. L. Ferguson, K. van Lente and R. Hitchens. *Am. Chem. Soc., J.* 54. *pp.* 1279–1290, *April,* 1932.—An improved method of making a "free diffusion" type of static junction is described, and it is shown that static junctions of the type 0·1 *M* HCl/saturated KCl or 0·01 *M* HCl/saturated KCl must be made under very definite conditions to be reproducible (to less than 0·0001 volt) or constant for some days (to ± 0·00004 volt). The junction between 0·1 and 0·01 *M* HCl is constant and reproducible within the limits of dependability of the AgCl electrodes used or within 0·00002 volt. The potential of the cell-system Hg-HgCl-saturated

KCl/0·01 M HCl/0·01 M HCl/saturated KCl-HgCl-Hg, commonly termed the boundary potential between 0·01 and 0·10 M HCl, is found to be 38·04 ± 0·04 mV. By means of an apparatus devised for the direct comparison of static, flowing, "stopped flowing" and stirred junctions, it is found that, for concentration cells of 0·1 and 0·01 M HCl, the potential is practically the same for junctions of all these types. For the junctions 0·1 M HCl/saturated KCl and 0·01 M HCl/saturated KCl, the potential depends on the type of the junction and the rate of flow, but the two junctions respond in different ways to certain treatments. The effective part of such a flowing junction is that contained in the first three cm. of the horizontal outlet tube. For the systems involving saturated KCl, the potentials with static junction are less empirical than those with flowing junction, the variations of the potential of the former with time being less than those of the latter with rate of flow. T. H. P.

3497. Photovoltaic Properties of Cadmium Sulphate. R. Audubert and Cécile Stora. *Comptes Rendus,* 194. *pp.* 1124–1126, *March* 29, 1932.—The deposit of cadmium sulphate produced on a cadmium anode in a solution of an alkali sulphate exhibits a marked photovoltaic effect, which is generally negative and is particularly large in oxidising solutions; in reducing solutions it is small or even positive. It is extremely small in solutions containing cadmium ions, and large in solutions containing alkali ions. Increase of pH causes an increase of the effect, and decrease may cause reversal, but the effect when positive is always very small. It is ascribed to the deposit functioning as a cadmium electrode. H. F. G.

3498. Becquerel Effect in Zinc Oxide. E. Bürgin. *Zeits. f. wiss. Phot.* 30. *pp.* 334–358, *April,* 1932.—The Becquerel effect is studied in aqueous suspensions of ZnO in the presence of oxidising or of reducing substances. Purely electrode effects were eliminated by shielding the (Pt) electrodes from the light throughout the experiments. Positive or negative effects may be obtained according to the composition of the solutions, but, in general, the phenomena are in agreement with Baur's theory of sensitised photolysis in general, and of the Becquerel effect in particular [see following Abstract] in that (1) zinc oxide alone (unary system) usually gives a negative effect attributable to oxygen adsorbed to the electrode; (2) in the presence of an oxidising agent (kathodic depolariser) a positive effect is obtained; (3) in the presence of a reducing agent (anodic depolariser) a negative effect is usually obtained; (4) the simultaneous action of anodic and kathodic depolarisers which, according to the theory, should give zero effect, produces a variable result attributed to a variety of secondary factors. The experiments are greatly complicated by the presence of traces of oxygen in the solutions, though careful measures, fully described, were taken to eliminate this factor. L. V. C.

3499. Theory of the Becquerel Effect. E. Baur. *Zeits. f. wiss. Phot.* 30. *pp.* 359–363, *April,* 1932.—Distinguishes the Becquerel effect from the Hallwachs effect (photopotential due to direct electron transfer at the surface of an electrode) and, as generally recognised, from photoconductivity. The Becquerel effect is considered to arise in two stages, the first being the excitation of atoms within the molecule, and the second a species of molecular electrolysis resulting from the intramolecular field between the oppositely-charged products of the primary action. Whether the two stages are completed to give, *e.g.*, electron liberation (Becquerel effect) depends upon quantum considerations, which are analysed. The theory is supported by the phenomena of sensitisation in photolytic systems. L. V. C.

3500. Recording Apparatus for Potentiometric Estimations. P. Dubois. *Comptes Rendus*, 194. *pp*. 1162–1164, *April* 4, 1932.—The solution under examination is placed in a revolving beaker, inside which is fixed a silica tube containing an electrical resistance, the combination serving as a stirrer and to regulate the temperature. An electrode in the solution and a standard electrode connected through a galvanometer measure the progress of the reaction. The reagent is added from a burette attached to a balance, a mirror being attached to the knife-edge support. Light reflected from this and from the galvanometer mirror falling on photographic paper suitably moving gives the record. C. A. S.

3501. Improved Commutator for the Measurement of Overvoltage. A. L. Ferguson and G. M. Chen. *J. Phys. Chem.* 36. *pp*. 1156–1165, *April*, 1932.—A commutator is described which makes it possible to measure charge or discharge potentials within 0·0003 sec. from the beginning or end of the charge and discharge intervals for the electrodes either combined or separately. Several sources of error that may enter into the measurements of polarisation potentials by the commutator method have been pointed out. H. H. Ho.

3502. Measurement of Polarisation by the Direct and Commutator Methods. A. L. Ferguson and G. M. Chen. *J. Phys. Chem.* 36. *pp*. 1166–1177, *April*, 1932.—A commutator was used which enabled potentials to be measured within 0·0005 sec. from end of charge or beginning of discharge. The system permits the measurements of every potential drop in the complete circuit, and their sum can be compared with the source potential. Measurements were made for anode, kathode and total potentials at several points on the charge and discharge intervals, practically simultaneously, without stopping the interrupter, so that curves could be plotted for complete cycles. It is shown in the case of platinised electrodes in 2 N H_2SO_4 that there is no surface resistance of any kind for current densities between 3·8 and 150 mA. With smooth platinum electrodes the decrease in discharge potential was so rapid that satisfactory results could not be obtained with the interrupter potentiometer system. H. H. Ho.

3503. Moving Boundary Method for Measuring Transference Numbers. E. R. Smith. *Bureau of Standards, J. of Research*, 8. *pp*. 457–461, *April*, 1932.—The volume change which occurs at the electrode during the measurement of transference numbers was determined by a pyknometric method. The results show that the measurements in the case of Ag : AgCl in KCl solution agree with the value obtained by calculation from the densities of the electrode material and the solution within the limits of the precision required. F. J. B.

3504. Electrolytic Formation of Single Crystals. V. Kohlschütter and A. Torricelli. *Zeits. f. Elektrochem.* 38. *pp*. 213–227, *April*, 1932.—In order to study the conditions under which electrolytic precipitates form single crystals, silver was precipitated electrolytically from silver nitrate solutions at a single crystallisation centre using very small current densities. The curves between current and time are, for a constant p.d., of a type which depends upon the nature of the crystal growth taking place at the electrode. Linear curves indicate that undeformed crystal growth is taking place, discontinuities occurring when new faces appear or distortion occurs. F. J. W.

3505. Theory of the Separation of Chromium from Aqueous Solutions of Chromic Acid. E. Müller (with J. V. Robu and W. Hartmann). *Zeits. f. Elektrochem.* 38. *pp.* 205–211, *April,* 1932.—Aqueous solutions of pure chromic acid are not reduced by the electric current at platinum electrodes, but in presence of a small amount of sulphuric or perchloric acid the separation of chromium as chromium chromate takes place, these acids effecting depolarisation of the kathode. The reduction of chromic acid occurs far more readily at a carbon electrode than at platinised platinum; this appears to be due, not solely to the rough surface of the carbon, but also to the absence of a primary diaphragm of basic chromate on the surface of the electrode in this case. [See Abstract 2375 (1930).] T. H. P.

3506. Dissociation Constant of Acetic Acid from 0° to 35° C. H. S. Harned and R. W. Ehlers. *Am. Chem. Soc., J.* 54. *pp.* 1350–1357, *April,* 1932.—The dissociation constant of acetic acid was obtained from the results of e.m.f. measurements of cells H/HCl(m)/AgCl/Ag and H/HAc(m),NaAc(m)/NaCl(m)/AgCl/Ag. The measurements were carried out at five-degree intervals, from 0° to 35° C. The value for the dissociation constant obtained from these determinations was $1 \cdot 754 \times 10^{-5}$ at 25°, and the result agrees with the values obtained by Harned and Owen, $1 \cdot 75 \times 10^{-5}$, and with that obtained by MacInnes and Shedlovsky, $1 \cdot 747 \times 10^{-5}$, from conductivity measurements. [See following Abstract.] F. J. B.

3507. Dissociation Constants of Acetic Acid at 25° C. D. A. MacInnes and T. Shedlovsky. *Am. Chem. Soc., J.* 54. *pp.* 1429–1438, *April,* 1932.—Measurements of the electrical conductivity of aqueous solutions of acetic acid at concentrations ranging from $0 \cdot 00003\,N$ to $0 \cdot 2\,N$ were made at 25° C. Similar measurements were made on solutions of sodium acetate, in which hydrolysis was repressed by the addition of small quantities of acid, at concentrations ranging from $0 \cdot 0001$ to $0 \cdot 004\,N$. From the data so obtained and from data and measurements of the e.m.f. of cells containing hydrochloric acid and sodium chloride [see preceding Abstract] the dissociation constants of acetic acid at 25° C. were obtained. At the higher dilutions the value obtained for the thermodynamic dissociation constant was $1 \cdot 753 \times 10^{-5}$ and is in excellent agreement with the value obtained from recent e.m.f. measurements. F. J. B.

3508. Activity Coefficients of Alkaline Earth Metals in Aqueous Solution from Vapour-Pressure Data. J. R. I. Hepburn. *Chem. Soc., J. pp.* 1284–1292, *April,* 1932.—Activity coefficients have been evaluated from the vapour-pressure data at 25° for the chlorides of the alkaline earth metals in aqueous solution. The values obtained are in general agreement with those derived from e.m.f. measurements by other workers, passing through minima at approximately the same concentration. A correlation of the molecular lowering of vapour pressure with the activity coefficients computed in the present work showed agreement with the suggestion of Allmand [see Abstract 3232 (1927)], in that a minimum in the activity coefficient corresponded with a minimum in the molecular lowering of vapour pressure. AUTHOR.

3509. Electrolytic Dissociation and Activity Functions of Acids in Salt Solutions. Parts IV and V. E. Larsson. *Zeits. f. phys. Chem.* 159. *Abt.A.* 4. *pp.* 306–321, *April,* 1932.—In Part IV tables of results are given for (1) mono-, (2) di-, and (3) tri-alkylacetic acids. Acids of group (1) have values for $-\log \psi$ and $-\log \phi$ independent, within 0·02, of the constitution of the acid, but dependent on the nature and concentration of the salt. The same holds for group (3), but here the values are higher than those for group (1) for the higher salt concentrations. For 3 *N* NaCl or KCl the difference is about 0·07 on the average. The expectation that the values of $-\log \psi$ and $-\log \phi$ for an acid of group (2) would lie between those for acids of groups (1) and (3) is realised. In Part V the $\alpha\beta$-unsaturated acids are found to have values for $-\log \psi$ and $-\log \phi$ which, for the higher salt concentrations, are somewhat greater than those for $\beta\gamma$- and $\gamma\delta$-unsaturated acids. As a first approximation, the $\alpha\beta$-acids agree with one another, but for higher salt concentrations $\beta\beta$-dimethyl acrylic acid shows values differing from those of other acids. The $\beta\gamma$-unsaturated acid, vinylacetic acid, has values differing somewhat from those of the $\alpha\beta$-acids for the highest salt concentrations. Geometrical isomerism produced by a double carbon linking has no perceptible influence on the activity functions investigated. Tetrolic acids behave like crotonic acids, the doubly and trebly linked carbon atoms showing no difference in their action. At the higher salt concentrations an unsaturated acid always exhibits rather higher values for $-\log \psi$ and $-\log \phi$ than the corresponding saturated acid if the double linking is in the $\alpha\beta$-position to the carboxyl group. Vinylacetic and allylacetic acids behave like the saturated acids. The introduction of an unsaturated carbon linking into aliphatic acids has a perceptible influence on the activity function only if it is as near as possible to the carboxyl group. [For Part III, see Abstract 2198 (1932).] T. H. P.

3510. Behaviour of Amphoteric and Polyvalent Ions with Widely-Separated Charges in Electrolytic Solutions. G. Scatchard and J. G. Kirkwood. *Phys. Zeits.* 33. *pp.* 297–300, *April* 1, 1932.—Bjerrum's conclusions on the behaviour of amphoteric ions are discussed, and it is then shown that the effect of charge-separation alters with the concentration of the electrolyte in such a manner that the limiting law depends neither on the charge-separation nor on the form of the molecule, but only on the total charge. The activity of an amphoteric ion in dilute solution is therefore not proportional to the square root of the concentration but to the latter itself; and any polyvalent ion behaves approximately as a spherically symmetrical ion whose diameter depends on the charge-separation as well as on the molecular magnitude. H. H. Ho.

3511. Equation for Electrolytic Conductance. T. Shedlovsky. *Am. Chem. Soc., J.* 54. *pp* 1405–1411, *April,* 1932.—An equation for the conductivity of electrolytes is derived as an extension of the Onsager equation. It expresses the equivalent conductance of strong uni-univalent electrolytes in relationship to concentration up to about 0·1 *N* in aqueous solutions. The constants are theoretically calculable, and in addition to the limiting conductivity, the equation contains only one additional constant. [See following Abstract.] F. J. B.

3512. Electrolytic Conductivity of Uni-Univalent Electrolytes. T. Shedlovsky. *Am. Chem. Soc., J.* 54. *pp.* 1411–1428, *April*, 1932.—An accurate method of measurement of conductance of very dilute solutions is developed. A new type of cell was constructed in which disturbing parasitic currents were excluded. It was shown that the use of dipping electrodes led to erroneous results. Measurements were made of the equivalent conductance of NaCl, KCl, HCl, $AgNO_3$ and KNO_3 at 25° C., at concentrations from 0·00003 *N* to 0·1 *N*. The measurements were in agreement with the values obtained from the Onsager equation when considered as a limiting equation. Nitrates showed certain deviations which were ascribed to partial association. [See preceding Abstract.]
F. J. B.

3513. Equilibrium $H_2 + Cl_2 = 2HCl$ at High Temperatures. W. F. Giauque and R. Overstreet. *Am. Chem. Soc., J.* 54. *pp.* 1731–1744, *May*, 1932.—An approximate method of calculating the free energy from the energy levels of diatomic molecules without summing the Boltzmann factors for the individual rotational energy levels is given. The method considers the effects of molecular distortion due to rotation of the non-rigid molecules, without loss in accuracy The manner in which the presence of various isotopic molecules affects such calculations is discussed, and it is shown that equilibrium in the reaction $Cl_2{}^{35-35} + Cl_2{}^{37-37} = 2\,Cl_2{}^{35-37}$ is entirely to the left at 0° K. The values of $(F^\circ - E_0^\circ)/T$ for $Cl_2{}^{35-35}$, $Cl_2{}^{35-37}$, $Cl_2{}^{37-37}$ and the equilibrated mixture are tabulated for temperatures ranging from 250° K. to 3000° K., and similar tables are given for HCl^{35}, HCl^{37} and for Cl^{35}, Cl^{37} and their respective existing mixtures. The values of $\Delta F^\circ/T$ for the reaction $\frac{1}{2}H_2 + \frac{1}{2}Cl_2 = HCl$ and for $Cl_2 = 2Cl$ are given for temperatures up to 3000° K.; for the change in heat content of the first of these reactions the value −22,028 cal. per mol. at 298·1° K. is found. As regards the entropies for HCl and Cl_2 for the different isotopes and their mixtures, it is suggested that thermodynamic properties of substances composed of two or more isotopic molecules be based on an average set of energy levels, computed by weighing the several values in proportion to the abundance of their respective molecules. T. H. P.

3514. Selective Permeability and Polarisation of Membranes. (Miss) Choucroun. *Comptes Rendus*, 194. *pp.* 1651–1653, *May* 9, 1932.—Consideration of work previously published [see Abstract 3149 (1928)] suggests, as a rule of general application, that when two solutions of the same electrolyte but of different concentration are placed on either side of a membrane, the membrane will become polarised only if the charge on the walls of the pores and that on the more mobile ion of the electrolyte are of the same sign. H. F. G.